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1842.

# GEOLOGY

OF

# NEW-YORK.

## PART III.

COMPRISING THE

## SURVEY OF THE THIRD GEOLOGICAL DISTRICT.

BY LARDNER VANUXEM.

ALBANY:
PRINTED BY W. & A. WHITE & J. VISSCHER.
..........
1842.

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SAMUEL YOUNG,

*Secretary of State.*

*Albany*, 1842.

To William H. Seward,

*Governor of the State of New-York.*

SIR,

I have the honor to submit a Report on the Geology of the counties of Montgomery, Fulton, Otsego, Herkimer, Oneida, Lewis, Oswego, Madison, Onondaga, Cayuga, Cortland, Chenango, Broome, Tioga, and the eastern half of Tompkins, which together compose the Third Geological District of the State.

With great regard,

LARDNER VANUXEM.

Albany, *January* 1, 1842.

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# FINAL REPORT OF THE THIRD DISTRICT:

TO SERVE ALSO AS AN INDEX, HAVING THE PAGES AFFIXED TO THE DIFFERENT PARTS OF WHICH IT IS COMPOSED; EACH PART BEING ARRANGED IN CONNECTED SUCCESSION AS TO SUBJECT.

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# REPORT

OF THE

# SURVEY OF THE THIRD GEOLOGICAL DISTRICT.

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## CHAPTER I.

### PRELIMINARY CONSIDERATIONS.

THE Third District is formed of fourteen counties and a half, as enumerated in the preceding letter to Governor SEWARD. It therefore comprises, as will be seen on reference to the map, all the area which exists between the Pennsylvania line on the south, and Lake Ontario and Jefferson county on the north, and a line extending north and south to the limits of the State through Cayuga lake at the west, and the counties of Delaware, Schoharie, Schenectady and Saratoga at the east.

The rocks, or rather mineral products of the third district, belong to three systems, classes, or geological divisions. The first, or oldest to the Primary; the second, to the period which intervenes between the Primary and the coal, well known by the name of Transition class; and the third, to the Quaternary, which includes the alluvial, commencing with the newer pliocene or upper part of the Tertiary, and extending upwards, embracing the most recent deposits of our globe. In the third district, the Secondary class, which commences with the coal, and the Tertiary class, with the exception of its upper part as just mentioned, as well as the Volcanic class, are entirely wanting.

The rocks of the Primary class are in general readily known by their particles being crystalline, from their containing no rolled stones, nor organic remains either animal or vegetable, nor do they show those well defined lines of division so common to the rocks of the succeeding classes of sedimentary origin. They are the most ancient of all the rocks, as their name signifies, which form that part of the crust of the earth which is known, and therefore form the base or support of all the other classes, being inferior in position and consequently superior in age. They may be confounded with some of the volcanic rocks, as these are more or less crystalline, and contain neither organic remains nor rolled stones—the materials of which were derived from a lower position than the known primary rocks, and as respects their material are the oldest.

The rocks of the Primary class in the third district are few in number; they are of gneiss and granite chiefly, also of hornblende rock, primary limestone, and a few rare, partial aggregates of coccolite and table spar, the last rocks covering but very small portions or patches of the district.

The rocks of the Transition class in the third district are readily distinguished from those of the Primary class, by difference of position when both are present; by the former being in regular layers, more or less flat or horizontal, and apparently undisturbed; some appearing as if deposited as sediment, like mud, sand, gravel, &c. whilst others were separated from a solvent in the manner of lake marl. The greater number abound in organic remains, chiefly of sea shells or testaceous bodies, corallines, &c. also of marine plants or fucoides; a few only having been formed of terrene origin. All the species of organic bodies contained in this class are wholly extinct, many of the genera also, a number of which ceased to exist before the coal was formed. The greater part of the surface rocks of the district are of this class, and it is the most important class in every respect in the district.

The Quaternary class comprises clay, sand, loam, gravel, boulders, lake marl, calcareous tufa, bog ores, peat and soil. These products rest upon either, or both of the other classes, being superficial deposits.

In prosecuting this survey, the first object was to ascertain what were the different kinds of rocks which were found in the district, and especially those of the Transition class, being the most important; to note their mineral and fossil characters and associates, or products; the order in which the rocks or masses follow each other, as to age or superposition; and to group those together which intermix, or are connected by common characters. In this report the term *group* is synonymous with *formation*, which is not used, from having a twofold signification, and of a kind which tends to confuse the subject.

# CHAPTER II.

*Enumeration of the Rocks, in the order of their superposition, beginning with the oldest.—Also a Tabular View of the New-York System, and of the systems of deposit in the District; and the geographical distribution of the Primary System, and of the division of the New-York System in the district.*

The rocks and groups, as well as other geological products which were observed, have generally been made known in the annual reports of the district. They are as follows, beginning with the oldest or lowest, and ascending upwards, in sequence or succession, being the true order to the mind, though an inverted one to the visible or outward eye, so different is the law of sensation from reflexion.

## Table.

1. Those of the Primary class, which includes granite, gneiss, hornblende rock, &c. &c.
2. The products intermediate to the primary and the Potsdam sandstone, the latter being the beginning of a series which in New-York extends uninterruptedly to the coal in Pennsylvania inclusive.
3. Potsdam sandstone.
4. Calciferous group, consists of the calciferous sandrock and the fucoidal layers of the annual reports of the district.
5. Black river limestone, consists of birdseye limestone, base of the Trenton also, and the Chazy limestone of Emmons.
6. Trenton limestone.
7. Utica slate.
8. Hudson river group, consists of the Frankfort slate and sandstone, or rubblestone of Eaton, and the sandstone shale or shales of Pulaski.
9. Gray sandstone of the falls of Salmon river, &c.
10. Medina sandstone, or redsandstone of Oswego.
11. Oneida or Shawangunk conglomerate.
12. Clinton group.
13. Niagara group.
14. Onondaga salt group.
15. Water lime group.

16. Pentamerus limestone.
17. Catskill or Delthyris shaly limestone.
18. Oriskany sandstone.
19. Cauda-galli grit.
20. Schoharie grit.
21. Onondaga limestone.
22. Corniferous and Seneca limestone.
23. Marcellus shales.
24. Hamilton group.
25. Tully limestone.
26. Genesee slate.
27. Portage or Nunda group.
28. Ithaca group.
29. Chemung group.
30. Catskill group, or old redsandstone.

Finally the products which belong to the Post-tertiary age, which are here placed together under the head of Quaternary System, in order to avoid interference with arrangements elsewhere made. They form two divisions. The first consists of clay, sand, rolled stones, boulders and other blocks of transport, being all transported materials. The second division consists of lake marl, calcareous tufa, bog ore, peat or muck, soil and mineral springs; being products of the places where existing or discovered, excepting soil in part, being of twofold origin.

In commencing this report, I had no intention to make any arrangement of the rocks of the district from the Potsdam sandstone to the Catskill group, but a geographical one merely of the district, and in accordance with the strikingly peculiar features of that highly interesting portion of the State, intending also to content myself with a numerical distinction of the parts, and even to retain the term *Transition Class*, as heretofore used for that series, waiting for the fossil character of the whole State before entering upon the subject. Finding, however, that the geologist of the second district had adopted the term *New-York Transition* for the same series, but leaving out its upper member the Catskill group or old redsandstone; adopting also the well known names of *Champlain*, *Ontario* and *Erie* for some of the divisions of the class, the intention mentioned was abandoned, and the views of Dr. Emmons were cordially embraced and adopted with some modifications.

In this report the term *New-York System* will be used, and will include all from the Potsdam sandstone, inclusive, to the "Coal formation." As no part of the latter deposit exists in the State, with the exception of a few partial outliers or detached masses in the fourth district, consisting of conglomerate, which forms the lower part of the mass, the whole series in New-York being complete as far as the beginning of the coal era, the system has for its designation a name which geographically is perfect, leaving nothing more upon the subject to be desired.

The *New-York System*, by this arrangement, includes all the undisputed transition rocks, the "Coal formation" having always been debateable ground; one class of geologists placing it in the Transition, the other in the Secondary class.

In adopting the new term, an old one is gotten rid of with great advantage. It was odious to many, in consequence of its inappropriate meaning as originally applied: that import being disregarded by those who still retain it, considering it in no other point of view than as designating the class, system or division of rocks which exist between the Primary and the Secondary classes, without any reference whatever to its original meaning.

In adopting the terms *Champlain*, *Ontario* and *Erie*, there is no intention to make any other arrangement than one which, in great part, is purely geographic, the advantage being that these names are well known, and that the rocks included under their heads, respectively, are, with some exceptions, in force and well characterized along their border. In adopting the terms *Ontario* and *Erie*, for example, it must be borne in mind that reference alone is made to the geology of their southern or New-York border.

*Tabular View of the New-York System in the ascending order.*

| | | |
|---|---|---|
| NEW-YORK SYSTEM. | Champlain division. | Potsdam sandstone, Calciferous group, Black River limestone, Trenton limestone, Utica slate, Hudson River group. |
| | Ontario division. | Gray sandstone, Medina sandstone, Oneida conglomerate, Clinton group, Niagara group. |
| | Helderberg division. | Onondaga salt group, Water lime group, Pentamerus limestone, Catskill shaly limestone, Oriskany sandstone, Cauda-galli grit, Schoharie grit, Onondaga limestone, Corniferous limestone. |
| | Erie division. | Marcellus shales, Hamilton group, Tully limestone, Genesee slate, Portage group, Ithaca group, Chemung group. |
| | Catskill group. | |

With the above important and convenient arrangement, the whole of the rocks and other geological products of the third district will be reduced to a few simple heads, namely, four systems and seven divisions, as in the following table:

| | |
|---|---|
| 1. Primary System, .................... | Requires no further illustration. |
| 2. Taconic System, .................... | Embraces the products between the primary and the Potsdam sandstone, which are very partial in the district. |
| 3. New-York System, | 1. Champlain division.<br>2. Ontario division.<br>3. Helderberg division.<br>4. Erie division.<br>5. Catskill division. |
| 4. Quaternary System, | 1. Transported materials.<br>2. Local materials. |

In the preceding pages, it will be perceived that the whole of the geological products, usually so considered, of the district are arranged under three heads. The first, as *rocks and groups*, being the simplest result of analysis that with advantage could be obtained; properly speaking they are geological elements, and as such are considered. The second, as *divisions*, and are formed by one or more of the above elements. The third, as *systems*, formed of the divisions.

In determining what were the simple or individual rocks or masses, and their arrangement, though uninfluenced by the labors of others beyond this State, and our country, yet attention has been fully given to the facts and results made known, from their direct bearing upon the district, knowing the importance which they would have upon a question for example, like that of the presence or absence of coal in the district. Thus by the arrangement of the rocks in the Pennsylvania Reports, the whole, from what corresponds with the Potsdam sandstone, to the Coal series, both included, are embraced in thirteen formations. The first nine in the ascending order, extend to the Catskill group inclusive, and are called the Appalachian system. The four upper ones, are considered to form the Carboniferous system, the anthracite coal basins forming the upper or fourth formation; the bituminous coal being part of the same formation. A comparison in accordance with the results reported of Pennsylvania, show that three formations are wanting in the third district to connect its upper rock with the coal, that being the fourth formation, all which have no existence according to the report in the district.

In England, there is good reason to believe that the Cambrian system is but the disturbed part of the Frankfort series, or Hudson river group, and that probably neither the Silurian or the Cambrian systems inclusive extend so low as the Potsdam sandstone, nor higher than the Ithaca group; the Devonian extending from the Silurian, and embracing the Catskill group, which is its highest known number, the Carboniferous or Coal-bearing rocks, commencing at the top of the Devonian system, or the Old Redsandstone, and Catskill group. This result perfectly accords with the facts and conclusions made known in the New-York Reports, the highest rock of the district, being the base of the coal series, group or formation; and therefore all expectation of finding coal below that point, from all known facts obtained from Pennsylvania, Great Britain, and the State, is perfectly futile.

To such as are interested in the geology of the west, it may be useful to state that the lowest mass, observed in the States of Ohio and Indiana for example, belongs to the upper part of the Champlain division of the New-York system, and extends from the Trenton limestone to the top of the sandstone shale of Pulaski. It is considered to be one mass; contains the fossils of those two periods; the lower part called the Blue limestone, the other the Blue marlite. The next mass is the Cliff limestone, which extends upwards to the Marcellus shales, and contains the well known fossils of the Ontario, and Helderberg division. The third extends to the coal; the Waverly sandstone of Ohio showing the same peculiar fucoids, the Cauda-galli, which are found in many parts of the Erie group in New-York.

The arrangement adopted, in a measure happily accords with several great geographical features of the third district, which are all important to enable one readily to comprehend and retain in mind the surface distribution of the many different rocks or masses, which are found in the district. As usual the first, or lowest in position, will be the first in order to be considered.

*Primary System.* It forms a part of the great central elevated mass of the second district, extending south and west, covering the northern part of Montgomery county, the north half of Herkimer, the northeast corner of Oneida, and the whole of Lewis county, to the east of Black river. The direction of its outer margin is nearly northwest and southeast through Lewis, Oneida, Herkimer, and the west half of Montgomery; from thence it curves to the northeast.

*Taconic System.* It is only found in a few points of the northeast part of Lewis county, and requires no further notice at present.

*Champlain Division,* is the first of the New-York system. It immediately follows the Primary along the whole of its course, and with considerable regularity as to parallelism. The upper member of the division extends beyond the south boundary of Montgomery, with the exception of a corner at the southwest of the county. It ranges through Herkimer and Oneida, from two to five miles to the south of the river, the limit upwards in those two counties well defined geologically by the Oneida conglomerate, which rest upon it as far as the town of Westmoreland. Its breadth, south of the river, increases from Utica. It changes its east-southeast direction at the south-southwest of Taberg village, for a north course, passing out of the district by a curved line into Jefferson county, returning by a short curve again into the district, and covering the northwest part of Oswego in the towns of Sandy-Creek, Pulaski, and the skirts of the towns bordering upon the latter ones.

*Ontario Division.* This is less regularly disposed in the beginning of its course than the preceding one. It commences about where the county of Montgomery joins the counties of Schoharie and Otsego, and extends into the fourth district. In the beginning of its course, the Oneida conglomerate and Clinton group first appear coming out from under the base of the Helderberg division, showing their northern outcrop. In going west they are joined by the Niagara group near Oneida county, and by the gray sandstone which first appears at Woodruff's quarry to the south of Rome, the Medina sandstone not appearing in place to the east of Oneida lake. The Ontario division widens greatly to the west of the Chenango canal, covers the whole of Oswego county, excepting the part occupied by the preceding division, passes to the south of Oneida lake, and extends thence in nearly a west course through the district.

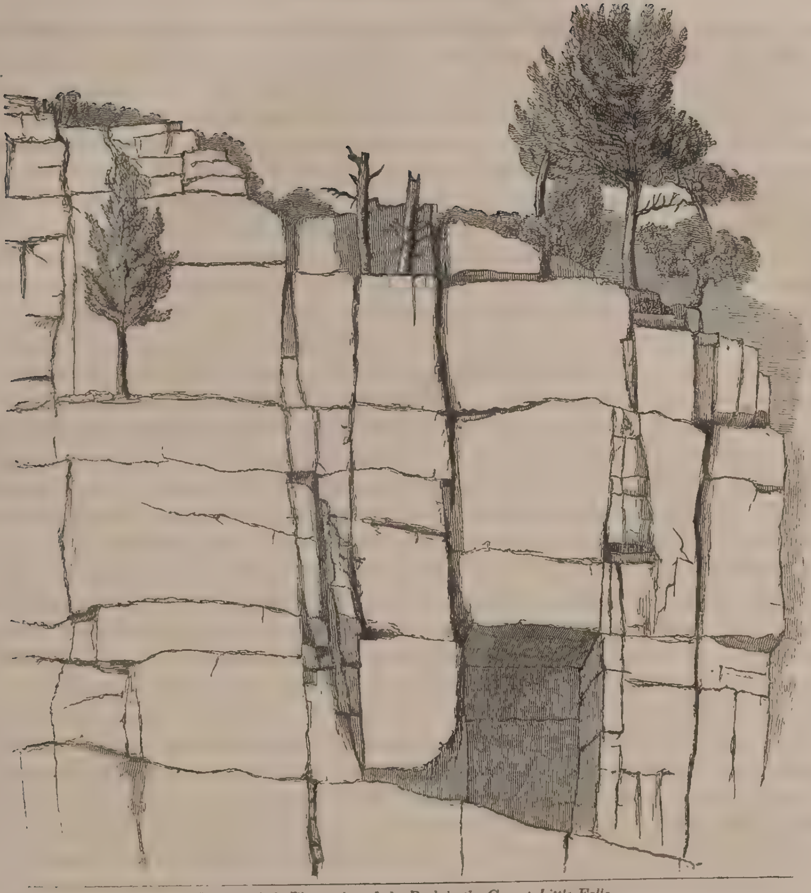
The whole of the rocks of the division, from where it spreads out, show a surface arrangement of great regularity; the oldest to the north, the newest to the south; the one following the other in regular succession, which is the case also with all the rocks of the district west of Oneida county.

*Helderberg Division.* With the exception of the Onondaga salt group, this division is extremely well defined, being readily traced from the Hudson to Niagara river. With the exception mentioned, and some valleys and ridges, it rarely exposes a surface of more than three or four miles wide, in all its long course. The Onondaga salt group which forms the lowest member is coëxtensive with it. It is but a thin mass near the Hudson, exposing merely its edge or northern outcrop, but thickens and spreads out in its progress west, rapidly exposing more and more surface in its onward course from the west of Oneida; its breadth averaging in the counties of Madison, Onondaga and Cayuga, about ten miles. The Helderberg division is the termination upwards of all the limestone masses of any considerable thickness or purity, or which range through the district. With this division a system of north and south valleys and lakes commence, which are parallel to each other, and are found every few miles upon its surface, from the east to the west of the district.

*Erie Division.* This commences on the top of the Helderberg division, and ranges continuously with it throughout its long course, being the mass under which that division disappears. It has no existence whatever, north of the lower division, in the district or State, and its several members appear in regular succession, in going towards the Pennsylvania line, though with no regularity whatever in their line of outcrop or appearance. It covers the whole surface south of the great range, or Helderberg division, with the exceptions of portions of the counties of Otsego, Chenango, Broome and Tioga, which contains the Catskill group.

*Catskill Group.* This is the terminal member of the New-York system, founded upon an important geographical character. It is restricted altogether in the district to the four counties above named. It covers the southern part of Otsego; the middle and eastern portion of Chenango; the east and south part of Broome, and the greater part of the area in Tioga which extends from the Pennsylvania line to near the Susquehanna river. It is the uninterrupted extension west of the Catskill mountain range, which diminishes in height and thickness entering the district.

1.



*Characteristic Illustration of the Rock in the Gap at Little-Falls.*

# CHAPTER III.

## PRIMARY SYSTEM;

### CONSISTING CHIEFLY OF GNEISS AND GRANITE.

THE whole of the primary rocks of the district, with the exception of a few insulated patches, are placed at the north part of Montgomery county, the north part of Herkimer, the northeastern part of Oneida, and the whole of Lewis county east of Black river. They form a continuous mass, being the south and west part of that comparatively immense and beautifully circumscribed nucleus, which from a height, according to Professor Emmons, of nearly six thousand feet, descends with great irregularity, and disappears under the transition rocks which encircle it, and which border the St. Lawrence, the Champlain, the Mohawk and the Black river. To the southwest, the primary rocks do not again appear, until they rise to form the Ozark mountains of Arkansas, and the Iron mountain of Missouri.

The primary rocks of the district belong to the third range of the United States. The ranges differ in many of their characters, and in their geographical position. The first is the granite, having the characters usually given of this rock. It contains few extraneous minerals, is deficient in limestone, in iron ore, and disposed to decomposition. It is an extensive rock from Virginia south, and is the first rock which is met with going west from the coast. The second range is the gneiss. This is the same in all respects with that of the east part of the State, and extends through the Union, being placed between the other two ranges. Its characters and associates are pretty uniform throughout its long course. The third differs greatly from the other two: Mica is rare; amphibole more abundant; less disposed to decomposition than the two other ranges; rich in magnetic iron ore, which is only incidentally found in the others, showing no mine of it in either of those ranges. The third range is extremely rich in extraneous minerals, and lies to the west of the other two.

A reference to the map will show the boundaries in the third district, of the Primary and Transition classes. Through Lewis county, Oneida and Herkimer, they are well defined, being natural ones formed by Black river, the valley of Black creek and Spruce creek. In Montgomery the boundary is wholly artificial, and a reference to the map is necessary to understand it. The great mass lies to the north of the road which leads from Garoga Post-office, by Lasselsville to Brocket's bridge, on East Canada creek. East of the Post-office, after crossing Klip Hill, it pursues a northeast course, keeping within a mile or two to the northwest of the villages of Kingsborough, Mayfield Corners and Cranberry Post-office, to Sacondaga river; down which river it passes on the northeast side, forming the high hill or low mountain which runs parallel with the river, and for a mile and more from its bank. It joins the high range of primary hills in Saratoga county, of which it forms a part. In the four counties, its outline is that of a segment of a rude circle.

The characteristic features of the Primary region are its high insulated ridges, with parts more or less level between them; the extent of level surface somewhat considerable, in which are numerous lakes, ponds and meadows. The most hilly portions seen, were near to the east side of Montgomery, the greater part of the northern portion of Herkimer, the northwest part of Oneida, and the east part of Lewis; the hills diminishing north, corresponding with the slope at the northwest of St. Lawrence county. Some of the hills, such as Oak mountain, Royal hill, Kingsbury mountain, &c. appear to owe their elevation above the surrounding surface, to the same cause which raised the Noses, Little falls, &c., their forms elongated and mural being too regular and abrupt to be the relics of denudation. These high abrupt primary ranges are more numerous in Saratoga county, and show the Champlain division of rocks at their side, and facts probably will there be found which will settle the question of their elevation. The uplifts on the Mohawk conclusively prove, that besides the general uplift of the whole mass of the primary, partial uplifts of the same mass took place; and there is no reason whatever for restricting that action to that valley exclusively. In the examination of the Primary region, it is a fact of much interest to ascertain whether local uplifts took place; and if so, to what extent the surface has been changed by them.

The whole of the Primary region, with the exception of a few parts near its border, with the other class of rocks, is yet almost without an inhabitant. One mass of unbroken forest is stretched over its surface, operating greatly to prevent the action of the sun upon its soil; thus diminishing sensibly the mean annual temperature of the whole region, and sheltering swarms of insects, a pest to man and beast. Very little inducement has heretofore existed to settle that country; so much land of the highest grade of natural fertility surrounding it, with good roads, mills, schools, churches and other improvements, essential to civilized man; whereas, within that region, all is yet a wilderness; not that it ought to be one, but merely from the circumstance that no farmer will settle on primary soil which is not calcareous, if he can get a calcareous one; and so long as limestone, slate and other superior soils could be had at a reasonable rate, the primary ones of the wilderness could not be settled. With the rapid advance in population around the whole of the border, settlements will be extended within the wilderness, and every advance from the outer part of its circle will, in a high ratio, diminish the space to be settled. At the rate that improvements have gone on in western New-York, a half a century can not pass away without the forests of that region being levelled, and its arable land put in cultivation. Gneiss and granite form the great mass of the primary rock, the former, in general, very different from the gneiss of the second range; containing less mica, and its other constituents, quartz and feldspar, often showing the same parallelism as in mica, with less tendency also to alteration and decomposition. The gneiss and granite often alternate with each other, showing a like origin for the two rocks, as might be inferred from their composition being the same, the difference being merely this, that in gneiss the smooth surfaces of the mica are arranged in parallels, whereas in granite no disposition of the kind exists; a difference which probably may be found to be of no greater importance than noticed in other rocks, some of which show, in parts, but few divisions, whilst in others they are more numerous. In the rocks which succeed to the primary ones, the divisions into layers and courses are almost, if not invariably, formed by argillaceous matter, usually fissile; and the more homogenous the mass, should it be of carbonate of lime, the fewer are the layers or parallel divisions. In the upper mass of the chalk in the neighbourhood of Paris, there are no divisions excepting those formed by the layers of flint, which are arranged in parallels; and were it not for the flint, the chalk would, like the granite, show no lines of division dependent upon composition, and therefore not stratified; the granite, like the chalk, where not water-worn, also shows a mass whose surfaces are parallel to each other. The predominant colors of the granite and gneiss are red and greenish, owing to the feldspar, which is usually of those colors, and is in excess as regards the two other constituents. The mica is generally black, the quartz white and glassy. At Little-Falls and in other places the feldspar shows a disposition to assume, in parts, the porphyritic character, presenting crystalline particles, which are globuliform and not angular, manifesting the same law as in gypsum and other minerals, but upon a minute scale.

Associated with gneiss and granite there are a few other rocks, but they are rare in the third district; some of them formed by one or more elements of granite or gneiss, with amphibole or hornblende, forming sienite, granito-sienite and hornblende rock; likewise some aggregates of which granular carbonate of lime is the base, and others more rare, in which we find pyroxene and table or tabular spar. It is with hornblende rock, granite and gneiss, that magnetic iron ore, the characteristic ore of the range, is usually associated. Another and a common occasional aggregate is that of gneiss and granite with garnet, which was seen in place, in several localities, but is often met in boulders, as well as the hypersthene rock, which was not seen in the district in place, and probably was derived from the second district, where it is an abundant rock.

The *rensselaerite* of Dr. Emmons occurs in the district, near to Lewisburg furnace, where the white variety predominates. It is also found to the east of Boonville, some distance from the river, from whence very beautiful specimens have been brought. This mineral, from its great beauty, the high polish which it admits, the facility with which it can be worked, and from being found in considerable quantity, will in great measure supersede many of our common mantel ornaments of stone, as well as other smaller ones.

The primary rocks cover but a very small area of the district, in comparison with the two eastern ones; further details, therefore, would seem superflous, as full illustration will be given by the reporters of those districts, expecially by Dr. Emmons, being but an appendage to his central mass; also by the mineralogist of the State: the subject being again introduced in this report, under the heads of those counties where these rocks form a part of the surface.

The wood cut No. 1, placed at the head of the chapter, is a good illustration of the joints or fractures which this rock usually presents in the district, when it shows a mural surface. It was taken by the side of the Utica railroad, facing the river at the east end of the gap at the uplift of Little-Falls.

The localities where the primary rock appears insulated from its central mass, showing itself as a protruded body, are but few in number. The first along the Mohawk going east is at the Noses, being found on both sides of the river, at the east end of the uplift, rising on the south side to about one hundred feet; the greatest height being at some distance from the river. It shows itself in three distinct patches on that side, and but one on the other, all of different heights, the result of an original uneven surface; for the whole mass there, from the undisturbed state of the calciferous and other rocks which rest upon it, must have been raised as one body.

The next place along the Mohawk is Little-Falls. There the primary rock attains to nearly the same height, at the east end of the uplift; its surface dipping west, and disappearing under the river and its superincumbent masses. The rock exhibits a local character of some interest, which was noticed with detail in the report of Herkimer county. Some of the numerous vertical joints on the south side of the river are coated with red oxide of iron, often very bright, the rock showing the like color for some inches from the surface of the joints, the protoxide of iron of the feldspar having been changed to the peroxide. These appearances are of interest; for heated air must have been the agent of conversion, the coating must have been an exudation, and therefore yellow, and such would also be the color of the altered part of the rock, if it were the result of ordinary causes of change.

The third locality where it forms the base of an uplift, is at Middleville, just above the dam, on the west side of the creek, and also in the bed of the creek. It shows but about ten feet of height, being covered with alluvial under which it disappears.

The fourth and last place noticed, where disconnected as to surface with the central mass, was in the road from Lasselsville to St. Johnsville. It rises but a few feet above the surface, and is evidently encircled by the calciferous sandrock.

## CHAPTER IV.

### TACONIC SYSTEM, OR INTERMEDIATE PERIOD;

(*A name given by* Dr. Emmons, *from the mountain range at the east boundary of the State.*)

The want of parallelism between the layers, beds or divisions of the Primary and the New-York system, proves a derangement of the first anterior to the deposition of the latter; and the rugged or rounded outline, and the smooth surface of the primary at the uplifts where uncovered, shows it to have been water worn before the deposition of the succeeding class. This fact is important, proving that the chain or series of rocks in the third district are not complete, and that masses are wanting to fill the intermediate space. To the period which elapsed between the two systems, we should place all those parts of the Cambrian system of England, which hold a position inferior to the Potsdam sandstone, should any there exist; for from observation here, a Cambrian system could occupy none other than the vacant or intermediate space, unless of a particular character.

*Products of the Taconic System, or Intermediate Period.* Upon the primary at the northeast of Lewis county, occasionally patches are met with which belong to this period; they were noticed in the Report of 1840. They consist of lamellar white limestone with specular iron ore, and of compact red iron ore; these occur near Lewisburg furnace, and in the neighborhood of Harrisville. From the lower part of the Potsdam sandstone enveloping the same kind of ore, and covering such masses, a connection between the two exists, the sandstone being the terminal deposit.

To this period also the plumbagine rocks at Mr. Cleaveland's, in Lewis county, are to be referred, the whole being obviously what are termed *metamorphic rocks*, in its proper acceptation. These rocks will again be adverted to under the head of Lewis county. At present we would merely observe, that great obscurity exists with respect to them in the district; but probably full light will be thrown upon them from observations in the adjoining one, or further to the east. The surface of the rocks of the Primary system was without doubt deranged and water-worn, before the products in question were deposited upon it; the confirmation of which is the covering of a mechanical deposit in the Potsdam sandstone and its conglomerate, being the products of broken up and water-worn preëxisting rocks. The chief obscurity arises from the connection of the same ore, and other products, with the two surfaces, which may have been caused by exudations of different kinds from the primary rock, which filled up the fissures near its surface, incorporating themselves with the sand, &c. deposited upon the surface; the whole of which, by the agency of crystallization, undergoing a change of character, giving rise also to a connection not easy to solve without much investigation.

From the little to be seen of the Taconic system in the district, it might readily be considered superfluous; but by directing attention to it in this prominent manner, a full investigation will follow. Moreover it is a convenient receptacle for deposits which belong neither to the Primary or the New-York system; and the mind in England is disposed to one of the kind, since the Cambrian system holds the same position. From the necessity of a connecting link between the *Primary* and the *Secondary classes,* which alone existed when WERNER rose as a geologist, we owe the *Transition class,* the fruits of which are, the *Cambrian system* of Mr. SEDGEWICK, the *Silurian* of Mr. MURCHISON, and the *Devonian* of Mr. PHILLIPS; now merged, with the exception probably of a portion of the Cambrian, in the *New-York system.*

# CHAPTER V.

## NEW-YORK SYSTEM;

### WITH A DETAILED ACCOUNT OF THE ROCKS AND GROUPS TREATED, IN THE ORDER ENUMERATED IN THE SECOND CHAPTER.

Few countries, if there be even any, are so happily circumstanced as New-York, for the investigation of the rocks of the system which bears its name. The greater part of the Mississippi valley, and more especially the east side, is composed of its rocks. These rocks extend thence through Ohio and Pennsylvania in a northeast direction, enter and cover the whole of the northwest half of New-York, and retain the same undisturbed and horizontal position, so characteristic of them in that valley. On the east side of the Mississippi, from Alabama to the northern part of Pennsylvania, no higher rocks are seen upon their surface than those of the Coal series; and this series is found in the States of Tennessee, Virginia, Kentucky, Ohio and Pennsylvania, the series terminating in the latter State, but reappearing in the British possessions in a northeast direction.

In the west, few or no profound excavations exist; and a considerable extent of country generally must be travelled, in order to obtain knowledge of more than a few of them. In New-York it is widely different. By the same cause which excavated Lake Ontario, excavations at higher levels were made, disclosing the ends, or the outcrop of the rocks, giving rise to a succession of surfaces and cliffs, unparalleled in number, magnitude and range, extending from Niagara river in an east line, beyond the Hudson. The cliffs attain, in Herkimer and Otsego counties, the aggregate height of nearly one thousand five hundred feet, their rocks slightly inclining to the southwest. These are followed by others to the south, in regular succession, but no regularity of surface outline, the terminal one of the whole series being the rock upon which the coal of Pennsylvania is placed; the nearest locality of this fossil production, or its series, to the third district, being about twenty-five miles south of the line of the two States.

These excavations east and west, by which the outcrop of the whole range of southwestern rocks of the Union were exposed, have been no less advantageous to the industry of the State than to the geologist. They have given to New-York, in connecting the eastern with the western waters, a reduction of level fully equal to one thousand two hundred feet.

In the valley, at the foot of the cliff of the two counties before mentioned, a series of uplifts appear, commencing, or rather terminating, a short distance to the south of the Mohawk, widely deranging the surface of Montgomery to the north of the river, and in less degree that of Herkimer county. These uplifts show the lowest rocks of the west, and the lowest rocks of the third district; exhibiting, from the Mohawk valley to the coal of Pennsylvania, the whole series of "Transition rocks."

With the exception of the Coal group, the series in New-York exhibits all the rocks of the west, with others not yet observed; presenting the most perfect succession for number, extent of range, abundance of fossils, undisturbed position, and facility of examination, of any yet discovered. This State, therefore, should be the place to refer for a knowledge of the rocks of this ancient class; and the change of name to the *New-York System*, is truly an appropriate one.

To form some idea of the scale upon which the rocks of the United States have been projected, a comparison, in few words, with Great Britain, may not be uninstructive to many, and not out of place. That little territory, of which England is the head, is emphatically a geological epitome of the world. It embraces all the classes, the groups and rocks generally, and the lesser products; all which are admirably developed. It is solely to this fact, and the patient industry of its cultivators, that England stands at this time at the head of geology. But how small the scale in Britain when measured by that of the United States! Here the whole Union, north and south, extending from the Atlantic to near the Pacific, is required to show what is contained within the small compass of its three kingdoms.

England, from the resources which she draws from the earth, and to which, in no small degree, her greatness is owing, has fully proved that soil and subsoil are to a nation what body is to mind; nor can such be accidental in a world of cause and effect, where chance can have no existence; for "measure, number and weight," are connected with all things. Considering the relationship as certain, how great the destiny of our States, when measured by the geological scale of the two nations, the people of the greater territory being the descendants chiefly of the lesser one.

In proportion to the resources, the industry and the intelligence of a people, where no restraints exist, so will be their power, security and happiness. Agriculture is the basis of civilization; but those who pursue it, if alone or insulated, could not attain to any great degree of either bodily comfort or mental culture; hence, when connected with commerce, a wider door is opened by the exchange of each other's productions, and comfort and knowledge thereby proportionally increased. As these progress, mechanics and manufactures gradually advance, the advancement of the whole being in proportion to the number and amount of resources from whence to draw; the soil, the waters, and the interior of the earth being the three great reservoirs, the whole embraced within the circle of geology.

With the Transition class a new era commences. As the Primary class is distinguished for its crystalline products, being preëminently the domain of *crystallization*, showing that solution reigned universally; a new element is here introduced, that of *life*, giving rise to an

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important class of characters, whose full development, as in man, forms no part of any of the past known geological eras.

Of all the characters which rocks present, there is none upon which so much reliance can be placed, to connect distant parts of the same country, or to connect countries even widely remote from each other, like those of organic remains. These bodies are all essential, and the chief reason why so little progress was made, excepting in local geology, was the want of a knowledge of fossils. In proportion to their investigation, so has our sphere of comparative geology extended, requiring but a few more years to complete our knowledge of the subsoil of the whole inhabited world.

There is yet some skepticism as to the value of fossils as a character to determine the position of rocks ; and sufficient attention is not paid to the obvious fact, that the value of the character increases, as the knowledge of these bodies increases with the one who uses it.

Fossils are of two kinds : those whose range is limited to one rock, mass, or short period ; and those whose range extends through two or more, their value depending upon their range being also limited, though several rocks or simple groups or formations be embraced within their range.

Though all the fossils of the same era of different countries may not present specific identity, yet no fact is better established in geology, than that there is identity for some of them, and that others are analogous only to those of the same era, being dissimilar to those of a different one. In any given country where a series of fossiliferous rocks exist, this is the fact, that on comparison with the series of another country of the same class, the same analogous order or sequence is observed in both.

Since the study of the fossils which are antecedent to the Coal or Carboniferous era, in other words, those of the New-York system, it is well ascertained, that they cannot be confounded with those of any other class or system ; that the plants of the Coal era are peculiar to that era, and to none other, and so are its numerous testaceous and other marine fossils which are found with its limestone. The like fact is equally well established for the fossils of the Secondary class, which cannot be confounded with those of the Tertiary, or these latter with the more modern or recent ones.

The same remarks, which apply to the classes, equally apply to the divisions of a class. Thus the divisions established by Mr. Murchison for the Silurian system of Wales, are readily recognized in New-York, showing that the same order of different kinds of fossils follow each other in the two countries ; leaving no doubt upon the mind of general causes having operated in the two countries in the same order of succession, showing a distinct fossil character for each division ; and not in these two countries only, but in others more widely remote, the same series in the same order existing in northern Russia, as ascertained on examination by the same distinguished geologist.

The divisions of the Secondary class, such as the new redsandstone, the lias, the oolitic series, the greensand and chalk, are equally distinct from each other in their fossil character, and we have no difficulty in knowing to which of these European divisions our Atlantic redsandstone is to be referred ; or the Gryphæa ——, brought by Nuttall and Townsend from the head of Lewis river, or the G. pitcheri, from the Falls of Verdigris river in Arkansas, both being referable to the lias. In like manner, such is the identity of some of the species, and the analogy of others, that no one believes that there is any other mass in Europe to which the marl or greensand formation of our Atlantic coast could be compared, and consequently referred, than the three chalk masses of France, including the greensand of England, the base of the chalk of Europe.

The same is true also of the Tertiary and its minor divisions; the creative power acting simultaneously over the globe, as to eras, has, from the beginning to the present, gone on step by step, arrested only by locality, producing a defined series of organic beings as to species, in which no re-creation of species in reality appear, but apparent ones merely, constituting one system, by which the mind readily arrives at the source analogous to the one from whence Egypt obtained her orphic egg.

To this geological sequence, with those acquainted with the subject, there is no valid objection — being matter of fact; but a difficulty appears to exist in the mind of some, as to whether analogous products of different countries were created or produced at the same given time, or at periods subsequent to each other. But this can be of little consequence, even in theory, and none in practice, when we know of no intervening products, and of no facts which show a pause or cessation of production, except locally, either for limited or great areas: it being of little consequence geologically, whether a day, a year, or a million of years elapsed between analogous products of distant countries, should none other have been formed between those periods — geology taking cognizance of the masses which exist, or had existed, and not of periods of time in which nothing was produced.

The fact that there is no repetition in the chain of creation, must satisfy every thinking mind, that from the beginning as made known by investigating the earth, but one system or series of visible organic beings have existed, and that the end or limit to creation from that source of knowledge is known, *man being the final result;* and such must be the truth, believing that he is so organized as to have perfect mastery over his body or acts, and for the same great ends relatively, that the "Father of all" has over the universe. That this high attainment for man is no groundless assumption, is evident, first, from accountability being the prime principle upon which jurisprudence is founded, every court of justice giving practical illustration of the freedom of the will, in relation to all the powers and acts of man. Secondly, from its accordance with the positive request from the greatest admitted authority: "Be ye perfect as your Father in heaven is perfect." And finally from the full confirmation, by the "Book of the Wisdom of Solomon." There these words are written: "For God created man to be immortal, and made him to be an image of his own eternity." Nor can a higher state of existence be conceived from what we know, than that which man by perfect obedience to the superior power can attain. This knowledge of succession and progression without repetition in the chain of creation, is of the utmost importance, proving the existence of a law whereby stability is given to the whole system, which it could not have were there repetitions.

## 1. POTSDAM SANDSTONE.

*Potsdam and Keeseville Sandstone.*

(No. 1. Pennsylvania Survey.)

This name is applied by Dr. Emmons to an important rock for thickness, extent, and for economical purposes, which exists in the Second District, being the first mass going north towards Lake Champlain, and further west, which rests upon the primary, the calciferous sandrock being the next rock as to age; and when together, they rest upon the sandstone. It appears to form two distinct varieties in that district, one of which is found at Potsdam, the other at Keeseville. This rock corresponds in position, etc. with No. 1 of the Survey of Pennsylvania, and is common to New-Jersey, but in both these States it resembles the Keeseville and not the Potsdam variety.

In the third district this rock is rather rare, and confined chiefly to the northeastern part of Lewis county, unless from change of character it is confounded with the calciferous sandrock. It presents two varieties in Lewis county, the locality not far from Lewisburg furnace: a conglomerate of quartz, the fragments chiefly angular, with a few other fragments of primary rock, forming the lower part of the mass; and a sandstone above, exhibiting the same characters in all respects as at Potsdam, being in very regular horizontal layers or courses, from an inch to a foot or more in thickness, striped, of a reddish and yellowish color, and of rather a coarse and loose texture. The sandstone appears in a few low insulated ridges about two miles from the furnace, and also near Harrisville.

Towards the Mohawk, the sandstone is found on the west side of Klipp hill, or the north prolongation of the Noses, extending from the turnpike which goes to Johnstown, for about a mile and a half towards the south road. Numerous small patches there exist, some of which are composed of two layers: one hard and whitish, the other friable, and colored brown and red. They rest upon the primary rock in the usual unconformable manner, and were, no doubt, once parts of a continuous mass destroyed with the former overlying rocks.

The layers which occur between the primary rock and the calciferous, at the paper-mill on Spruce creek, may be refered to this rock. There the characters are somewhat different, though the material is in a great measure the same, being a coarse grey rock, resembling in parts, at first sight, a recomposed granite; that is, a granite whose mineral constituents had been separated and re-united again, without much if any change of place. The first layer is about six inches thick, and contains fragments of vitreous quartz, which are likewise found in some of the layers a few feet above.

At the base of the well characterized calciferous mass on the Mohawk, below Canajoharie, and on West Canada creek, below Middleville, etc. there are a number of extremely hard compact layers, whose fracture shows a glistening grain, as if composed of sand united by a siliceous cement, as if the particles had come together by a partial softening and pressure.

These layers, from the absence of lime, or this substance not being obvious to the eye, resemble portions of the Potsdam ; and having the same composition, and holding the same position, may readily be confounded with it, and in fact be referred to either mass, should there be no defined line of separation between the two rocks, none as yet having been noticed in the district.

About half a mile below Canajoharie, in the cliff by the road side, the rock which is above the lower hard solid layers, is in one place much fractured, and in grain and color being a light red, could not be distinguished from the sandstone of Potsdam. The surface of some of the fragments has anthracite adhering to it, and in forms which show that this substance had been in a soft or yielding state. With it, there is also that variety of quartz called *mullen glass* or *hyalite*, having the same fused appearance as the anthracite, the particles of the two substances having been in similar states, and have separated, no doubt, from thermal water.

In this district no organic remains have been seen in this rock, nor any in the second district, excepting the Lingula, at Keeseville, where, according to Dr. Emmons, it is in great abundance. The Potsdam sandstone being the most ancient rock of the Transition class, or New-York system, its position in the series being perfectly well ascertained, the existence of this fossil as the oldest yet known, is a fact of some consequence to those who despise not small things, aware that all things are significant. The genus Lingula appears, from this New-York fact, to be the oldest known ; and, as Mr. Conrad remarks, being also a recent one, the *genus* has lived through all ages of known organic existence.

That variety which resembles the sandstone of Potsdam, is an excellent building material, holding mortar well ; and from not condensing moisture so readily as those rocks which are more dense, it makes a dry house. It forms a first rate lining for iron furnaces, and is used at Lewisburg for that purpose. It is a good guide, at least on the north slope of the Primary region, for the discovery of iron ore. There, between the surface of the primary rock and the base of the sandstone, the compact red oxide and the specular iron ores have been deposited. The former ore is exceedingly abundant, and is used at Lewisburg furnace, but brought from the second district. The same kind of ore is found by the side and base of a sandstone ridge, about a mile and a half from the furnace ; but no body has as yet been discovered, though from the abundance of iron froth which exists in the fissures of the rock, and amongst the rubbish at the foot of the ridge, it is reasonable to suppose that ore yet exists under the sandstone, and was not all swept away by the same causes which have destroyed so great an amount of rock in that region, as well as in almost every part of the globe.

## 2. CALCIFEROUS GROUP.

*Calciferous Sandrock, and Transition Sandrock of Eaton.*

(No. 2. Pennsylvania Survey.)

The term *Calciferous sandrock,* as it does not comprehend all the masses of the district which are synchronous with it, the more comprehensive word *group* is now used. It embraces, generally, three distinct masses, as to character and position. These alternate and intermix with each other.

The first is siliceous, compact, and may probably be the continuation of the Potsdam sandstone, either in part, or almost wholly.

The second is a variable mixture of fine yellow siliceous sand and carbonate of lime, which, when fractured, presents a fine sparkling grain. It is in layers, but they rarely show that very regular structure which usually belongs to a limestone rock. They have a shattered appearance from numerous cracks, the parts being more or less separated from each other. This is the mass from whence the name *calciferous sandrock* was derived.

The third is a mixture of the calciferous material, which is usually yellowish, very granular and sparkling when fresh broken, and of compact limestone, which resembles the birdseye limestone in its mineral character, containing also some argillaceous or slaty matter. These materials often have the appearance of having been deposited in thin alternate slaty layers, but more or less intermixing with each other, the birdseye appearing to have been passive when aggregating, whilst the calciferous particles, on the contrary, were active, shooting into ramose forms, which might be confounded with the fucoids which are found with these layers. The action of the weather upon these layers is very peculiar, giving to them, after long exposure, the appearance of gothic fret work, and in the district are characteristic of this rock. The color also becomes a dark yellowish brown. These materials are often associated and coated over with a greenish slate or shale, which sometimes is ochrey by alteration, and are the bark-like layers of the late Prof. Eaton; the whole mass having been designated, in the annual report, by the name of *Fucoidal layers.*

In the annual reports, the fucoidal layers were separated from the calciferous sandrock, in consequence of always observing that they were above the great mass of the latter rock; overlooking the fact, as it appeared to be of little importance, that the fucoidal layers were always covered by a few or more layers of the calciferous rock. A re-attention to the subject was caused by the observations of Dr. Emmons in the second district, where the mass above the fucoidal layers is greater than the one below it; the combined observations of the two districts showing that the two constitute a group, in which the fucoidal layers are included, and therefore a subordinate mass. Though these layers are made up generally of parts which are thin, they are often in layers of two or even several feet in thickness, and of considerable regularity, and by this character are readily distinguished from the layers of the other masses. They make a good building stone, and are quarried for the enlarged Erie canal at Sage & Reed's quarry, south of the Mohawk; at Canajoharie, at Tripes hill, &c.

Fossils are rare in the calciferous sandrock; but in the fucoidal layers there are many individuals, though the kinds are few. Most of them are peculiar to this rock, and will subsequently be noticed.

The Calciferous group is confined entirely to the counties of Montgomery, Herkimer, Oneida and Lewis. It occupies a large portion of the space in Montgomery county, which lies between the Mohawk river and the Primary region, but is concealed to a considerable extent by alluvion, which is abundant in all that part of the county where this group forms the surface rock. The calciferous sandrock is found but in few places on the south side of the river, in none of which does it extend for more than a mile from the river. In Herkimer, it is confined to the margin of East Canada creek, to the valley of Spruce creek, to the uplift at Little-Falls extending on both sides of the river, and lastly to West Canada creek, commencing about three and a half miles below Middleville, and extending to the line of Oneida county, into which it projects a mile or two, being the only place where the group was observed in that county. In Lewis, which is the last of the counties where the group exists, it is equally as limited as in Oneida, appearing only on the road between Lewisburg furnace and the Natural bridge, and on the road from the bridge to Carthage; the latter locality, however, may be in Jefferson county.

It is not unlikely that the calciferous sandrock runs out in its progress through Oneida by East Canada creek, as it was not seen in any part along the range of the primary through Ohio, Oneida and the Black river; nor was there any fact observed along the same range, to induce the belief that a fault existed by which the primary was upraised, concealing the rocks below the Black river limestone in Lewis county. It is very possible, that from a change of character not attended to, the calciferous may in part form the base of that limestone. Not knowing the calciferous sandrock in New-York, but as it appears on the south side of the primary range in the third district, there was nothing to show that a change of character had taken place, especially if connected with a rock little developed in the district.

The fact made known by Dr. Emmons, that the calciferous rock which rests upon the fucoidal layers is thicker in the second district than the same mass below the layers with fucoids, which knowledge was acquired at the close of the survey; the fact also of the water lime burnt at Van Eps's on the Mohawk, near the line of the third district, being above those layers; the presence of similar layers in the northeast part of Lewis county, and of the Potsdam sandstone; these facts, together with that of the total absence of the calciferous sandstone in all that region, so far as was observed, require, in order to obtain greater accuracy, that as the Black river limestone is of considerable thickness in Lewis county, the lower part should be re-examined, and by one acquainted with these masses as they exist in the second district, where, according to Dr. Emmons, they are of great thickness, and embrace his Chazy limestone, a mass not noticed in the third district.

As a marked difference of character exists between the calciferous sandrock and the fucoidal layers, though they form one group from the intercalation of the latter, they will be treated of separately, from the rule which separates objects that are different.

*Calciferous Sandrock.* The greatest exposition of this rock is at the four greatest uplifts, such as the Noses, particularly at the east end; at Little-Falls, Middleville and St. Johnsville; very little of the fucoidal layers being seen at those places. At these, and at other localities, the characters of the rock are similar: generally fine grained; somewhat sparkling when fresh fractured; of a yellowish grey, which becomes darker when long exposed. Besides these general characters, it exhibits numerous others not necessary to detail. Its layers are irregular in their outline, contrasting strongly with the fucoidal layers, and especially with the birdseye limestone in that respect. They are usually much fractured when long exposed in a cliff. It forms a thick mass at all the places mentioned, being upwards of two hundred feet thick at the Noses and Little-Falls. There are many other points where it also appears as a cliff, showing a considerable mass, such as the continuation of Flint hill at the east end of the district on the Mohawk river, the quarry opposite St. Johnsville, and some other places, as must be obvious from the amount of surface which the rock shows in Montgomery county; but these do not require a more particular notice.

From the composition of this rock, consisting of carbonate of lime and silex, it was highly favorable for the forming of other products, when placed under circumstances admitting of solution, this being the first step towards production.

At Little-Falls, in many parts of its mass there are thick layers, showing a concretionary structure, as in the agate; but when in great mass, the material is coarse, usually presenting a series of dome-shaped bodies, placed side by side, of an inch or more in diameter, and more or less regular: occasionally they appear globular. The former kinds are composed of the rock; the latter is of silex or flint entirely, which is common also, but not in great masses. Some of this latter kind presents the more common forms of agate.

At the Noses, siliceous concretions are more abundant, and in greater variety. One of the best points for observing them is on the south side of the river, and at the east end going by the road which leads by the side of the uplift. Among the various forms are the oolitic; the oolite particles opaque, their cement glassy quartz. Others show that minute or very thin layers had formed, and were subsequently broken up, the edges in parts slightly rounded and diminished in thickness, as though solution had commenced before the whole were cemented or made solid. The oolite was found in many other localities, such as Spruce creek, a few miles above the paper-mill; Fish-House, &c. The surface of the rock, at the falls in East Canada creek in Manheim, shows numerous places where thin layers had been formed and broken up, and the parts disposed with a regularity not unlike particles of iron when placed upon glass and subjected to the influence of magnetism, or particles of another kind when acted upon by electricity.

Among the other siliceous productions to which the solution of the rock has given rise, are quartz crystals. These are in some places in great number, and numerous perfect ones have been found as to form and transparency. Their interest is greatly increased by association with anthracite coal, the latter substance often existing within the crystals. The crystals occur in the cavities of the rock: these cavities are usually very irregular as to form, and differ greatly in size, varying from mocroscopic to a yard in diameter. With these two products, *i. e.* crystals of quartz and anthracite, we often find lamellar carbonate of lime, rhombic crystals of the same, and also magnesian carbonate of lime, the latter in rhombic crystals also. The shattered conditon of the rock, and its loose texture generally, show the extent of chemical action to which it was subjected; its composition and its position in the series, being upon the primary mass, highly favoring that action.

The Noses, Little-Falls and Middleville, are the three best localities for these products, though they are found at numerous others, as stated in the Report of Dr. Beck.

At Spraker's Basin, the parts containing the crystals are not far below the fucoidal layers. Some of the cavities show, first a lining of lamellar carbonate of lime; then a deposit of anthracite, in parts intermixed with that mineral, and then the quartz crystals. In others quartz crystals line the cavities in part; the anthracite being mixed up with it, and covering the surface, which shows a depression towards the centre.

At Little-Falls, the cavities are very numerous, but small, the crystals of quartz often lining the cavities; the rhombic crystals, usually of magnesian carbonate of lime, adhering to the crystals. Numerous cavities also exist, whose sides are covered with anthracite in a state resembling dust; and in others, this substance is seen, having the appearance which we would suppose it would assume, were a few drops in a highly fluid state to fall upon the bottom of the cavity, and then congeal. Specimens of this kind are common in the small cavities of the rock thrown out in enlarging the canal, to the west of Little-Falls, not far below the first lock from the village.

At Middleville, the large cavities are in greater number, the rock crystals are more abundant, and more perfect as to form and limpidity, than in any other known locality. A greater proportion of anthracite has also been found associated with them at that place; the quantity, however, hardly sufficing to meet the demand for cabinet specimens.

Some of the cavities have been known to yield nearly a half a bushel of crystals. When so large, the rock is more porous or loose in its texture, and the crystals less perfect as to form and clearness. The more compact the rock, and the fewer the crystals, the more perfect they are in all respects, In some of the cavities, a coating of coal has been found, covering the crystals; they occupying the lower part, and the surface of the coal depressed towards the centre, showing that it had been soft, or in a yielding state. In breaking into a cavity, an explosion sometimes takes place, probably owing to a partial vacuum, into which the air rushes to restore the lost equilibrium on being fractured.

The fact long observed elsewhere, has been remarked here, that the crystals of the same cavity have usually one and all a common family resemblance, and differ from those of another cavity, should the cavities differ as to form; the sides of the cavities exerting an influence upon the forming crystals. These crystals are much sought for, as objects to gratify taste, and as beautiful specimens of mineralogy.

Anthracite has been an object of exploration in many places where it appears in this rock, in the hope of discovering this valuable product in profitable quantity; those who sought it having no idea that coal was limited to a small part of the geological series, and that this rock was far below that part in which it so exists. One of the excavations, and the deepest, is at the top of the Noses, to the north of Spraker's house; the depth attained is said to have been sixty feet.

The anthracite of this rock, from its appearing in the form of drops or buttons, and as before noticed, proves that its previous nature was bituminous, its own being infusible; and shows the heat, not dry but humid, to which the greater part of the rock had been subjected, and which readily accounts for the numerous siliceous and other products which are common to it. An analysis of this anthracite gave 86½ per cent of carbon; 2 of light cream-colored ashes, which were of silex; and 11½ of water, the latter being in greater amount than has been obtained from the anthracite of the Coal era or series.

The rock, in part, gives a fetid odor; and there are few rocks out of the Primary class, containing organic remains, but do the like; a phenomenon which appears to be caused by animal matter, and which may be perceived in almost all the rocks belonging to the New-York system, at the moment of fracture, or when struck by a hammer.

But one place was seen, where the calciferous rock showed any other metallic minerals than a little copper pyrites and iron ochre, or hydrate of iron: this was on the land of Josiah Rice, near Salisbury Corners. Several small openings had been made there; but the parts, when visited, were too much covered up to observe positively whether veins existed or not. The appearance presented was that of irregular deposits, filling cracks, etc. in the rock. The ores were galena in cubo-octohedrons, copper and iron pyrites, and sulphuret of zinc, all in small quantities.

Copper pyrites, forming rather handsome specimens, and in considerable quantity, as cabinet specimens, were thrown out in blasting this rock to the west of Little-Falls, in the enlargement of the canal, but no other metallic mineral noticed with it. The same kind of pyrites, but in minute quantity, may be seen in the same rock in the creek near Spraker's basin. Sulphate of barytes is often found at the west end of Little-Falls.

From the state in which the anthracite appears, and from the abundance and varied kinds of siliceous aggregates embodied in the calciferous sandrock, little doubt can exist of its having been connected with thermal waters.

*The Calciferous sandrock*, resting immediately upon the primary, as its position shows at the Noses, Little-Falls and Middleville, the two masses being very different as to age, and with no conformity as to structure; the effect of this difference would be, that whatever derangement the primary mass might receive, it would not be communicated to the other in the same manner, from want of parallelism: hence separations or caverns would be formed, into which surface waters would find their way, and thus be subjected to the high temperature to which this rock, from its low position in the series, has been subjected.

In the range of this rock through the Atlantic States, there are numerous points where it shows that thermal action existed; and there appears to be little doubt that the springs now in action, such as the Hoosick, the Buncombe in North Carolina, the Virginia and the Arkansas, have their source at the bottom of this rock, whose range extends northeast and southwest through the Atlantic States, though with some considerable change of character, being in thicker and more regular layers, of a grey or blue color, and a purer limestone.

Fossils are extremely rare in the calciferous rock in the third district: all that have come under notice, or been heard of, are two lingulæ of unknown species, found at Little-Falls. None were seen there by myself, except a single fragment of a spiral univalve, resembling a common turretted shell, which, when whole, was probably an inch and a half in length, and another fragment resembling an orthostoma. At the east end of the Noses, on the north side, and at the top of the cliff near the river, two or three small casts of univalves were found, but too imperfect to determine the species or even the genera.

A rolledstone of this rock was found by Dr. Eights in Saratoga county, containing the Lingula acuminata. They covered the surface of the fractured parts, showing from sixty to seventy valves in an area of three by two inches.

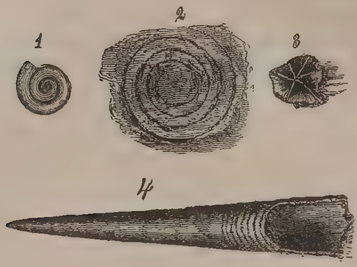
From the loose texture of the rock in many of its parts, it was highly favorable for the percolation of water, many of its products manifesting that action; which doubtless may have destroyed many of its fossils, though very probably but few were deposited with its materials, the rock being a very extensive one in the other States, in all which, with one known exception, it is wholly non-fossiliferous.

*Fucoidal Layers.* These layers are well defined, and readily distinguished from the calciferous rock by their disposition in thick strata; many parts of which, when long exposed, show a structure as if formed of numerous thin ones. The mineral composition is more varied, showing frequently a mixture of the calciferous sandrock and the birdseye limestone, the latter rock being the successor to this group. It often presents ramose forms, usually composed of the calciferous portion: where these exist, there is always more or less shale associated with them. These forms are frequently so imitative, that it is often difficult to distinguish them from the fucoids, which are numerous in these layers, but rarely sufficiently distinct to determine more than their organic nature.

In parts the rock resembles a breccia, but of rounded particles, generally of compact limestone like the birdseye, and enveloped usually by a crystalline limestone. The particles are of various forms, as flat, round, etc.; they are evidently accretions, parts of which were thin layers broken up, partially dissolved, and cemented together. The character of the layers varies in different places, the parts of which they are composed varying as to proportion, crystalline action, etc.

Besides fucoids, it contains other fossils, many of which are peculiar to the rock: they appear to be more numerous where the birdseye mixture exists. The annexed wood-cut exhibits four of the most characteristic fossils of the group. The whole are of interest, being the lowest fossils of any discovered in the third district.

2.



The cut represents these fossils in their natural size: No. 1, is a small spiral undescribed univalve, drawn from an imperfect specimen, exhibiting merely the general character. The whirls or coils are more numerous and slender than those of the wood-cut, and the central ones raised, not being on the same plane. The proposed name is *Ophileta levata.* It was observed at all the localities of these layers on the Mohawk.

No. 2, is more remarkable, consisting of many convolutions, resembling a single coil of cord formed upon a flat surface, the diameter of the coil being usually about one inch. From analogy of conformation, it evidently appertains to the same genus with No. 1, and its proposed name is *Ophileta complanata.* It is more rare than the former, but is occasionally met with in the same localities on the Mohawk, and it is also found in Lewis and Jefferson counties. The shells of both species are exceedingly thin.

No. 3, appears to have been one of the plates of the head of an encrinite, having a like character. There are two general forms: one in which the slender divisions are irregular, as in the wood-cut, and showing but five in number; in the other three are six, and even eight, four formed by the greek cross, and the others by ridges transverse to the cross. Its locality is the quarry opposite to Fort-Plain.

No. 4. Orthoceras primigenia, the oldest and smallest of the genus yet observed. The specimens are all much corroded by the action of the weather, which, however, exhibits their structure to great advantage, showing the outer chamber which was the residence of the animal, and the inner ones, which were numerous and near to each other; also the terminal part, which, being more solid, is usually uninjured. These orthocera are found in considerable numbers in the quarry opposite to Fort-Plain, close by the side of the railroad.

At Flint hill, near the line of the district, other fossils were seen which no doubt will be noticed by the reporter of that district. They were an Orthis, in some measure resembling the Testudinaria; and the tail of a trilobite resembling the Illeneus.

Encrinal rings are obscurely seen associated with No. 3, and also at Canajoharie.

The fucoidal layers are readily observed along the road from Flint hill to Amsterdam village, appearing at the creek just below the railroad, and extending up the creek; at Tripes hill, being worked at the railroad, and in the little valley near the village, where an orthostema was found; at Sage & Reed's quarry, opposite to Tripes hill; and at the creek at Spraker's basin, below the falls where the Ophileta complanata was first seen. West of the basin, the layers appear in the side-hill, and by the road-side, projecting beyond the soil every few rods, the calciferous layers being below them; and thus, with little intermission, the two continue to near Fort-Plain.

The best exposition of these layers which came under notice, was at Canajoharie; there the rock is thicker and more extensively quarried, and the material of the birdseye limestone is also in greater abundance. The upper part of the quarry shows two layers, each over two feet thick, which are like those of the calciferous rock. They have undergone considerable change by exposure, and their color is yellow.

*Under these*, is a layer of dark color, fine-granular, sparkling in parts, and mottled; becomes somewhat olive by exposure to the air; composed of carbonate of lime and fine brownish black sand: thickness two feet.

*Under this*, a layer composed of the birdseye limestone with some black shale, the latter disposed in waved lines often crossing each other, but forming somewhat parallel divisions, and arranged in accordance with the layers. As the slate is small in amount comparatively, this layer would make a handsome marble; but to show the variegated appearance, it would require to be sawed obliquely. This particular layer greatly resembles many of those which belong to the Black river limestone in Lewis and Jefferson county. It is rare on the Mohawk, not remembering to have seen it but at Canajoharie. Thickness six feet; color grey dove.

*Under this layer*, there is one which shows numerous accretions, of all forms, but small, having the same mineral character as the one above, the parts united by crystalline limestone of the same color, and the accretions frequently showing a slight covering of green carbonate of copper. This is the most fossiliferous part of all the layers, containing the fossil No. 1, and fragments of a trilobite which probably belongs to an illeneus or isotelus.

The layers below these upper ones show but little of the birdseye limestone, the calciferous part with the shale predominating, the rock being uncovered for about twenty feet below the layers noticed.

The same layers, but with some change, are quarried to the west of Palatine bridge; they are also exposed for many rods by the side of the railroad, opposite to Fort-Plain. Numerous fragments of fucoids may there be seen, and it is the only locality of the Orthoceras primigenia.

Exudations of hydrate of iron are common to many parts of the side-hill at the quarry, consisting of the ochrey or bog ore, and appearing to have passed either from those layers or the overlying ones of the birdseye.

The layers extend along the road between Palatine church, and St. Johnsville. They diminish greatly towards the west, being very thin at Little-Falls, and appearing near the top of the mass. One of the places noted in that vicinity, was the old mill to the southwest of the falls.

These layers were seen at many points in Montgomery county, north of the Mohawk. They appear under the mill-dam at Cranberry Post-office, and are not thick, but straight;

the upper one of a dark color, with stains of yellow, and the others of a sandy color. A spemen of the Ophileta complanata was found here.

At Henry Deny's, in Clair's patent, the same layers again appear. At the Fish-house, to the east of the village, the rock is exposed in many places; likewise in Broadalbin, at the Eagle mills, and the creek between there and the Fish-house; in several streams from thence towards West-Galway, and at Hageman's mill in Amsterdam, etc.

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## 3. BLACK RIVER LIMESTONE.

SYNONIMES.—Birdseye limestone, Mohawk limestone, Base of the Trenton limestone, as used in the reports of the third district. Black marble of Isle la Motte, "Seven-foot tier," and Chazy limestone of Dr. Emmons, the latter mass connecting the birdseye with the calciferous sandrock proper. Metalliferous limerock, or Transition limerock of Eaton.

(No. 2. PENNSYLVANIA SURVEY.)

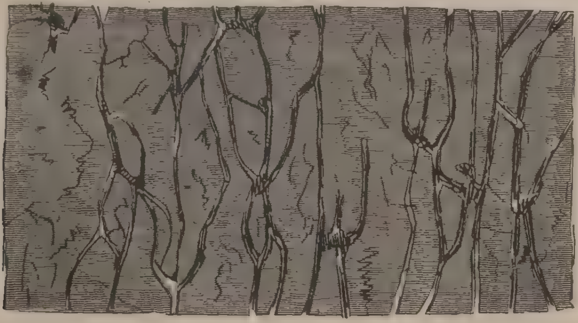
This term is applied to the first range or cliff of limestone on Black river, extending by the side of the river, from opposite Boonville, through Lewis into Jefferson county; the cliff being composed of the birdseye of the Mohawk, and the rock upon which the well-characterized Trenton limestone, in many of its localities is placed. It forms a convenient natural arrangement from association, from some common mineral characters, thickness, and as regards economical geology, the two rocks being much used as a building material.

At Fort-Plain, and other places upon the Mohawk, the change from the Birdseye to the Trenton limestone is perfectly abrupt, the two masses being in contact, one resting upon the other. The surface of the upper layer of the birdseye, at its point of connection with the superior rock, is thickly covered in many parts with the fossils of the Trenton limestone, which adhere to it, and not one of which is to be found below the surface of the birdseye; and reciprocally, those of the birdseye end with it. The only change visible in the latter rock, is a slight one in its mineral character towards the surface where the Trenton limestone rests upon it; the smooth fracture and the brittleness which characterize the rock giving place to the more scaly, granular and tougher nature of mass which, in some other localities, is placed between the birdseye and the well-characterized Trenton rock. This abrupt change from the one rock to the other at Fort-Plain, shows that a part is wanting to connect the two, and that part is found in some of the upper layers in the first range of cliffs on Black river, in the upper and lower quarry at Tripes hill, in the quarry to the southeast of Amsterdam, in Sage & Reed's quarry, on the south side of the Mohawk opposite Tripes hill, and in a few other places to be mentioned.

The name *Black river limestone* is substituted for the *Mohawk limestone* of the Report of 1840. In attempting to correct Mr. Conrad, I was led into a greater error, losing sight of the observations noted on Black river, and not having a common collection of specimens to resort to in order to understand each other. The term *Mohawk* was applied by Mr. C. to the intermediate mass, to which no name in this report is given but the *Base of the Trenton limestone.* This fact is one of many, to show the superiority of names given to rocks, taken from localities where but one rock or mass exists. The standard ever exists — it varies not; and its characters, associates and position can be ascertained by any one at the place after which it is named.

The Birdseye limestone on the Mohawk is readily distinguished from the other rocks by its light dove-color, which, by long exposure to the weather, becomes of a light ash grey or white. It is usually in thick layers, which are straight, having very little interposed matter between them; with vertical joints which are so straight and even as to give to the rock, where quarried, the appearance of a wall. In its grain, it is very compact; fracture smooth, and from being brittle, is an easy rock to work.

3.



The above wood-cut, from a drawing by Mr. Emmons, exhibits the *Fucoides demissus*, the characteristic fossil of the Birdseye limestone, as it appeared in the quarry at Fort-Plain. It is a faithful representation, upon a reduced scale, of a vertical section of a part of a layer of the limestone.

As the fossils of the State form a distinct department of the survey, no more illustration could be given in this report, than sufficed to show the character which these bodies give to the rock or group to which they belong.

The Fucoides demissus is found in this rock in every locality on the Mohawk. It is there very distinct, as in the wood-cut; the plant having been removed, and the cavities which it occupied enlarged and filled with green and black shale, which strongly contrast with the light dove-color of the rock. There and elsewhere, some of the fucoids are also replaced by lamellar carbonate of lime; the spaces occupied are white, and small in comparison with those of the former kind; and when few in number, are not so obvious. This is the case with the limestone along Black river.

This remarkable and eminently characteristic fossil is extremely abundant along the Mohawk. The most satisfactory locality for obtaining specimens of it, is at the quarry on the side of the river opposite Lower St. Johnsville, just above the ferry house. It is there replaced by lamellar carbonate of lime; and so gradual was the substitution of this mineral for its original material, and so favorable has been the action of weather and water, that the external form and internal structure are completely exhibited. The whole plant, or polypous animal, be it which it may, is composed of quadrangular cells more or less regular, arranged in groups from eight to sixteen in number. The form of the cells or openings at the surface or upper extremity of the fossil, when not broken, is somewhat circular, and gives to that part a fanciful appearance. These groups of cells are connected laterally with each other, by a more or less angular anastomose. This singular and interesting fossil, though so abundant in this limestone as before remarked, has not been found above it, nor below it.

The birdseye limestone is confined to the counties of Montgomery, Herkimer, Oneida and Lewis. In going west, on the south side of the Mohawk, it first makes its appearance at the village of Fort-Plain. It is there upon the calciferous, under which are the fucoidal layers, the Trenton limestone covering its surface as before mentioned. The rock is about ten feet thick, and it has been fractured in two places, causing one part to be a little lower than the other. It was wrought for the enlarged Erie canal. It shows exudations of hydrate of iron where fractured.

The next point west is Smith's quarry: it is a little to the south of the river road, and to the southeast of St. Johnsville. The quality of the stone of this quarry is much better than that of the one to the south of St. Johnsville; but there is not so much rock exposed, nor is its connection with the other rocks so obvious.

The quarry back of the ferry opposite St. Johnsville, is the third locality on the south side of the river. Besides the fucoids already noticed, the rock here contains cytherinæ in considerable numbers. I found also fragments of a trilobite, which appears to be new; a few tentaculites, and an orthocera not before noticed.

The layers in this quarry are much disturbed, and have furnished but little good stone; owing to the surface of the calciferous, which forms the floor of the quarry, being disposed in flat dome-shaped forms, to which the layers of the birdseye have conformed; it is not over six feet in thickness. On the south side of the quarry, the thin irregular layers of the Trenton limestone cover it as at Fort-Plain.

At Manheim ferry, the birdseye again is seen just opposite to the mouth of East Canada creek: also at the top of the uplift on the south side of Little-Falls; at the brook on the west side, near the old saw mill; and at the extensive quarry of Mr. Parmlee, about two and a half miles west of Little-Falls; just beyond which, it finally disappears under the water of the canal and its overlying rocks. The quarry is opened for some distance, and the layers are very regular, excepting where a few short low curvatures exist: their position in the quarry is nearly horizontal; the vertical joints straight, even, and wall-like. Fossils are rare: those seen were Fucoides demissus, Orthoceras ——, and a ramose polyparia found between two of the layers of the rock. An immense quantity of stone has been taken from this quarry, for the canal. It is worked rather to disadvantage, from the covering of thin irregular layers of trenton, of about fifteen feet in thickness, the whole of which requires to be removed as of no value.

On the north side of the Mohawk, the birdseye limestone first appears, in the small quarry back of Amsterdam, by the side of the creek near the mill-dam. The layers are few in number, and of no great thickness.

At Tripes hill, it appears by the side of the railroad, and forms the floor of the lower west quarry. It is a thin mass, and in thin layers much curved, and useless for a work like the one for which the stone above it is quarried.

The next locality on the river, is on the hill to the northeast of the railroad depot, opposite Fort-Plain, where it is exposed for a considerable space; but the layers are not very thick, and the joints are numerous. Beyond and back of Palatine church, there is a small quarry of the birdseye. At these two last quarries, the F. demissus is very abundant, and is replaced with green and black shale. This vicinity appears to have been the favorite residence of this extraordinary fossil, their number there being so much greater than elsewhere.

Further west, there are no other quarries of birdseye opened nearer than from one to three miles from the river. The first, are those of Helmick, Canada and Klock, to the northwest of St. Johnsville, on and near to Crumb creek; the two last are to the east of the creek, the former between that creek and East Canada creek. The rock lies near to the surface. At Canada's, it has in parts been worn smooth, and the stone shows cytherinæ and a small coiled univalve. At Schell's quarry, at the lower falls of East Canada creek, on the west bank, a number of the large Orthocera —— have been found; also a Cyathophyllum resembling the ceratites, the latter occurring near the top of the mass. These, with all others, will be noticed in detail, in the Report on the fossils of the State.

Stone from all these quarries have been taken for the construction of the canal, and from a few other quarries between this creek and West Canada creek, not far from Middleville. The latter creek is the extreme west limit of this limestone. These quarries are at Ingham's Hollow, and at Byers', in the town of Manheim; and again on the road to Herkimer village, below Middleville.

The other localities, where the birdseye limestone makes its appearance in the counties bordering on the Mohawk, are these: One by the road-side between Middleville and Fairfield village; at Newport, where it is much used in building; on the creek at the village of Ephratah; in the town of Mayfield, at Peter Fonda's; to the northeast of Amsterdam at Marcellus' quarry, better known by the name of *Schelpintown*. Besides these various places, it also appears in two insulated hills, between the quarry and Chucteronde creek, where it is burnt into lime; and here I first found cytherinæ in this limestone. The last locality noticed was at Ives' tavern, south of Black creek, on the borders of the Primary region.

We have been particular in enumerating all the points where this rock was observed, it being one of the most valuable of the rocks along the eastern section of the Mohawk for lime, and as a building material: the facing of the greater part of the enlarged Erie canal is made of it. It is solid, hard, and easily worked by reason of its conchoidal fracture, which makes it an inferior stone to the next mass above it in succession, where hard usage is to be encountered; the latter rock being more rare on the Mohawk, and not so easy to work.

*Black River.* The cliff which forms the western margin of this river, consists generally of a limestone in thick layers, the upper ones unusually thick. It is the surface mass, and forms a terrace, which, were it not for a few water courses which have in places removed it, would extend unbroken through Lewis county. Its mineral character is generally the same with the birdseye, especially the layers below the upper surface one; being rather brittle, and breaking with a smooth and flat conchoidal surface.

The cliff shows several distinct kinds of limestone, not being a homogeneous mass. The upper part is intermixed irregularly with black shale, and exhibits the characters and position of the mass intermediate to the birdseye and the Trenton limestone of the Mohawk, which position it also holds. It is not so good a stone as the lower layers, which are purer, and contain the Fucoides demissus replaced by white crystalline limestone, which, however, are not so numerous as in the same limestone on the Mohawk, but show identity in other respects.

The surface of the upper layer contains the remains of large orthoceræ, of a structure similar to that of the species duplex, and forming the genus Actinoceras of Bigsby, and Diploceras of Conrad. The edges of the cells, which extend from the internal to the external cone, give to this fossil, when broken or water-worn, the appearance of the backbone of a fish, and it is usually considered as such by the unpractised observer. Some of these orthoceræ are eighteen inches or more in length, and from three to four inches in breadth. In the same layer, near the mouth of Sugar river, I have found the Strophomena alternata, and the Cyathophyllum, which, if it be not the same, resembles the ceratites. The large and handsome chambered Columnaria sulcata, the same which is found in the thick layers resting upon the birdseye at Tripes hill, etc. is often seen in the exposed surface of this rock. The fossils, therefore, of this part, connect it with the base or immediate under-rock of the trenton, as it exists on the Mohawk.

Since the commencement of the Black River canal, considerable quantities of stone have been quarried near the mouth of Sugar river. The first layers are the same with those which form the bed of the river, and are not used: they form one division of the mass. The second division is of a lighter color, with less shale or impurities, more brittle, and contains the Fucoides demissus, Orthostoma, etc.: this is the part which is worked. The third division, and which there forms the base of the cliff, does not afford so good a quality of stone as the one above it, but contains the same fucoids; it is light colored, and the surface of some of the layers present mud cracks, showing the presence of shale. It is in these layers that the stone exists which is burnt for water-lime at Lowville: it is of a yellow color, becoming earthy after long exposure. These three divisions seem to be coëxtensive with Lewis county, having seen them in many points.

The cliff rises from the level of the river, a little to the south of the parallel of Boonville, and attains in its passage down the river the height of thirty, and even sixty feet above the water level. Not much, however, of its mass can be seen below the upper part, from the rubbish, soil, etc. which skirt its base. It is very likely that more of it will be discovered than was seen by us, but we can only give an account of that which was noted as having been examined.

The Black-river limestone has at its base or foot the primary rocks, the junction seen in no part. From its surface the well-characterized Trenton limestone rises, showing its usual mineral character, and its usual abundance of fossils. The two rocks, on the west side of the river, are coëxtensive with each other; but are seen together in one place only on the east side, namely, just above Wheeler's mill in Oneida county, nearly opposite to Boonville, and about four hundred yards from the dam. The Black-river limestone forms the bed of the river for a short distance above that point, and continues down for about a mile. In the bed of the river, some of the thin layers below the upper thick ones have been removed, causing these latter to fall, and give a curvature to the surface. The action of water on the east bank above and below the bridge, upon the same mass, has been great, deranging the surface, removing some of the lower layers, and forming subterranean passages. This, no doubt, has been caused by a portion of the water of the river, when very high, having found a passage between the layers, gradually removing them by wear and by solution, just as may now be seen near the mouth of Sugar river. At this latter place, the whole of the water, unless when in freshet, disappears by the vertical joints of the thick surface layer, and finds its way to Black river along the thin ones, portions of which are entirely removed. This is one of those instructive localities, where a ready solution is found as to the cause and manner in which caverns in calcareous rocks have been formed. These passages, some of which are like ordinary caves, may be seen just below the surface rock, back of the quarry before mentioned, and along the course of Sugar river, from where it disappears, to its mouth.

The vertical joints in the birdseye are more continuous in one direction than in the other; and this was the only one noticed by the compass, of which a record was found, being nearly east and west, and the other nearly at a right angle to it. At Parmlee's quarry, to the west of Little-Falls, the most continuous joints were S. 86° E.; and at Fort-Plain, the same sett were S. 82° E.; the others at nearly right angles as on Black river, making the common general direction N. & S. and E. & W. for the vertical joints of this limestone.

*Base of the Trenton Limestone.* On the Mohawk there are several quarries opened in a mass of limestone, which rests upon the birdseye, as may be seen in three of them, and in two of which it is followed by the well-characterized Trenton limestone. This mass, therefore, holds the same position as the upper division of the Black-river limestone, and contains some of the same fossils; but the mineral character is different, resembling more the grey limestone of the upper mass of the Trenton limestone.

These quarries are, Stanton's, on the south side of the Mohawk, about half a mile below Amsterdam; Putnam's quarry, on the hill to the east of the village of Tripes hill, and the quarry by the side of the railroad at the depot; Sage & Reed's quarry, opposite Tripes hill, on the south side of the river; Humphry's quarry, on the same side, between Fultonville and the Noses. Some of the layers at Amsterdam are referable to this mass, as well as a large portion of the rock quarried at Schelpintown.

In all these localities, the color of the rock is grey, lighter or darker in some than in others; has a crystalline grain; rather tough, and not so easy to work as the birdseye. Some portions contain knobs, the result of accretionary action, round which shale has accumulated.

The rock at Stanton's is a very solid mass, with very few divisions or layers; of a light grey color, and crystalline. Some of the layers or portions are over six feet thick. The lower layer is nearly seven feet thick; the next, four; the upper, about two. The rock is of good quality, with fewer knobs or accretions than in some of the other localities, and with more of the birdseye character than in the other quarries. The surface of the rock is water worn, being quite smooth in some places, and scratched, the direction of the scratches nearly east and west.

The limestone at Putnam's differs little from that of the quarry below the railroad. Its color is darker, but the mass is of the same thickness, and the layers and structure are similar. The top of some parts of the upper layer is bent downwards, owing probably to a want of uniformity in the material of the rock, some portions settling more than others, which is one of the principal causes why the lines of divisions in rocks are not always straight lines. The more homogeneous the rock, as is evident in some of the masses of the birdseye, the more straight the layers. Where it is mixed with shales, the layers are less straight.

One of the lower layers at Putnam's quarry, shows some scattered irregular pebbles, forming masses or accretions having the same character in all respects as the yellow-colored calciferous sandrock, and accurately resembling those observed in the quarry at Schelpintown; the largest of them are fully four inches in diameter, and of greater length.

These quarries are extensively worked, the stone being quarried for the aqueduct near the Cohoes. There is no better rock in the State for a work of the kind, due care being taken to select blocks free from shale, or containing but little of it, and that little rather disseminated irregularly through the mass than disposed in layers.

At Putnam's quarry, the rock is covered with alluvial, being the surface mass, the upper ones having all been swept away; but at the lower quarry, it is covered by the thin irregular layers of Trenton limestone. In both quarries, the birdseye may be seen below this mass, but is very thin. The mass worked is about twelve feet thick, and the same layer in some places measures from five to six feet in thickness. Some of the parts of this mass are of a lighter color and more compact character, showing that the cause which gave rise to the mineral nature of the birdseye had not ceased when this mass commenced to form.

Fossils are not numerous in either quarry; in which respect it contrasts strongly with the Trenton limestone proper, which rests upon it, and into which, as a limestone, it graduates; the difference being in the excess of shale in the Trenton portion, and the apparition of fossils not found below it.

The quarry of Sage and Reed is at the top of the first elevation back of the river. It is the third one on the Mohawk. Its thickness is not so great as the mass at Tripes hill. It is water-worn, showing scratches upon the surface, the direction of which is about east and west. The layers of this quarry are more numerous, and the accretions also more abundant than in the other three quarries. The mineral nature of the birdseye is obvious in the mass. The fossils noticed in this quarry were a strophomena; a large ramose form, supposed to be a polyparia, and which exists in the same position at Glen's-Falls; also Cyathophyllum ceratites? etc.; all which will be further noticed by the Palæontologist.

The same limestone occurs at Humphrey's quarry, on the south side of the river between Fulton and the Noses, and in the neighborhood of Amsterdam.

The Birdseye limestone is not confined to New-York. It is a rock in the geological sense. It forms the surface of Nippenose valley in Pennsylvania. It is the marble of Frankfort, Kentucky, forming there a cliff about thirty feet thick, and of a light bluish cream-color. Its layers are very regular, and formed by a slight accumulation of shale. Its fracture is like that of the birdseye of New-York, and it contains white crystalline particles such as exist when the F. demissus is replaced by this mineral. Above it, in places, are high bluffs composed of light-colored shale, and very thin interrupted layers of limestone, loaded with fossils, many of which are the same with those which characterize the Trenton limestone, and others have no analogy with those of any other known rock. The same masses exist in the bluff at Nashville, Tennessee; but the birdseye is of a brownish color, and in thin layers, the rock probably coming to an end in that direction.

## 4. TRENTON LIMESTONE.

*Metalliferous Limerock of Eaton.*

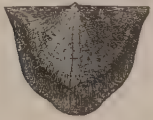
(No. 2. Pennsylvania Survey.)

This rock takes its name from the falls on West Canada creek, and the falls from the town of Trenton in Oneida county; in which, or by the side of which these rocks are placed, the line between Herkimer and Oneida passing in this direction. At Trenton falls, there are two distinct varieties: The first is a dark or black-colored fine-grained limestone in thin layers, separated by black shale or slate, and which forms the great mass through which the creek has worn its channel, and in which are all the falls; the second is a grey coarse-grained limestone in thick layers, which forms the top of the mass. Fossils are extremely numerous in the dark-colored part, but are less numerous in the upper or grey part: this latter kind is quite crystalline.

The Trenton limestone is extremely well characterized, especially by its fossils, a number of which are peculiar to the rock; and though others reäppear in one or more subsequent ones, they offer no difficulty in the recognition of this limestone, because there is not only a change in the mineral character, but they are accompanied by other fossils which had no existence in the Trenton rock. Fossil-like minerals have also a two-fold character; one which depends upon themselves as individuals, the other from association.

As a point or term of comparison for distant localities, the Trenton limestone, from the number of its fossils, as to class, genera, species and individuals, is one of the most important rocks of the lower part of the New-York system. In parts, it is loaded with the remains of animal life. In the preceding rocks there was but the dawn; in this, a full existence as to different kinds, and numbers especially of different kinds.

2



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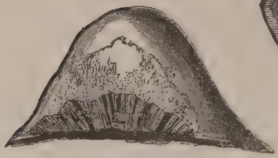

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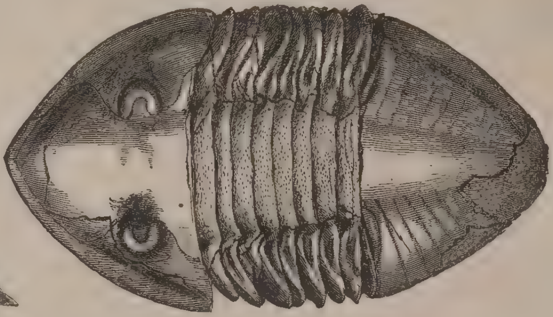

1

The fossil No. 2 of the wood-cut, Strophomena deltoidea, and of the Reports, is an exceedingly abundant fossil in this rock; and as far as a knowledge of its range has been acquired either in this State or elsewhere, it is restricted to it, and is therefore a characteristic fossil. It is in greatest number at Trenton falls, and the range generally of this limestone in Oneida county.

In a work like that of the survey of a State, where the object is to diffuse knowledge amongst the many, and not to the few only, a departure from common usage, where the obvious tendency was exclusive, should be made, be it ever so venerable from age, provided that the subject thereby is rendered simple and easy to be acquired. To attain this object, the specific name of the fossils will precede the generic ones as in our common language, and for the reason that the name of the species is more frequently used than that of the genus. The name, in all cases where new or doubtful, will be taken from the rock or group where it exists, or a locality equally characteristic. All received specific names will be rendered in the common language, as *Deltoid strophomena* for No. 2 of the wood-cut, no change whatever being made in those of the genera.

No. 3. The *Puffball favosite* (Favosites lycopodites), from its resemblance to that common fungus, is also highly characteristic, and is in great numbers; but it is found also in the lower part of the Utica slate, where it ends. It is one mass of small angular cells, arranged side by side. It is equally abundant at Frankfort, Kentucky, where it received the name of *Trianisites cliffordii.*

No. 1. The *Giant isotelus* (Isotelus gigas), size reduced one-third. This trilobite, the original of which is in the collection of the State, was found at Middleville. Fragments are numerous in almost all the localities of this limestone. More have been noticed at Fort-Plain, than at any other place. The range of this species is about the same as that of the Favosite.

The other fossils, which are abundant, and by association characteristic of this limestone, are the following:

*Open bellerophon* (Bellerophon apertus), has the same lower range as the latter named fossils, but reäppears in the sandstone shale of Pulaski, should the species be the same, which is not the opinion of Dr. Emmons.

*Semioval strophomena* (Strophomena semiovalis), is an exceedingly abundant fossil in the Trenton limestone, and has the same range with the preceding ones.

*Alternate strophomena* (Strophomena alternata), is in like number, with the same range.

*Tortoise orthis*, or Orthis testudinaria (Tortoise-shaped orthis), is in prodigious numbers, and occurs also in the sandstone shale of Pulaski, and likewise, but sparingly however, in the Water-limestone group, unless mistaken for a cognate species. Considerable difficulty, in fact, exists with this species; the individuals being in such profusion, that great attention is requisite to separate the incidental from the constant character.

Among the many fossils which also occur in this limestone, but are not so numerous as individuals, a few only will be mentioned.

The genus Delthyris commences in this rock, but the number of individuals in the third district is not great. In Ohio and Kentucky, this limestone is prolific of this genus. There are three or more different species in the district; the common one is the *Little-ear delthyris*, (D. microptera.)

Of orthoceræ, there are several in this rock, one of which has been found over four feet in length, not yet named. At Trenton falls, fragments of these large ones may be seen between the bridge and the mill-dam at the south or lower end of the gorge or excavation. The most characteristic *orthoceras* of the rock is the *Striated*, (Orthoceras striatum.) It is found in many localities, but more numerous at Trenton falls, towards the lower part of the mass. The O. duplex of Mr. Conrad also occurs, but it is very rare; the genus Actinoceras, to which it belongs, being rather confined to the mass intermediate to the birdseye and this rock.

Of the curved chambered shells, there are several: the most common is the Trocholites ammonius of Mr. Conrad, which is very numerous, but in one layer only, and in two localities as yet observed; namely, near Newport, and by the side of the creek between Middleville and Fairfield academy. This genus is as yet confined to this rock, and to the lower rocks of Salmon river, the Pulaski sandstone. The Phragmolites compressus of the same author, is also confined to this rock, but is extremely rare. In the collection at Trenton falls, there was a species of Cyrtoceras, about six inches in diameter, said to have been taken out of this rock at that place, but that genus has not been seen by the reporter in any lower rock than the Schoharie grit.

Of lingulas, two are found in this limestone: one small, the *Egg-form lingula* (Lingula ovata); the other large, not yet named scientifically, and may be called the *Trenton lingula*, being confined to this rock.

The beginning of perfectly preserved trilobites, as to the upper part of their external form, is in this rock. These first-formed, many-jointed, mailed bodies, must play an important part in the plan of creation, having held as it were the world to themselves, reigning without a competitor, during a greater part of the long period in which we find they had existence; for there is no evidence that any organic being greater than themselves, and endowed with an equal locomotive power, existed from the period of the Calciferous group to that of the Onondaga-salt group.

Next in abundance to the Giant isotelus (I. gigas) of the wood-cut, is the *Senior calymene* (Calymene senaria), being the first of the genus as to age. It is of frequent occurrence, especially towards the Mohawk, being more rare north of Trenton falls. Heads and tails are in some places very numerous, particularly in the neighborhood of Middleville. There are two species in this rock, which are blended together in descriptions, but nevertheless require separation.

The *Tessellated cryptolithus* (Cryptolithus tessellatus), begins in the Trenton limestone, and ends with it, if, as Dr. Emmons supposes, the one of the Salmon river series be different. The remains of this trilobite exist in great numbers near the railroad station at Tripes hill. Millions of heads must be there entombed, not one of which was seen with its body, nor are the parts of the body or tail readily observable. They occur also near Fonda, and in the first district at Glen's falls, in the same state; showing that they were not suddenly enveloped, or the lost parts would have been preserved.

In this very brief account of some of the fossils of this remarkable rock and period of the world's history, our object has not been to give an account of its paleontology, but to notice a few only, and those which readily serve to distinguish this rock, leaving all the other fossils for their proper department of the survey; and for a similar reason, many species are omitted, which have been described in former annual reports.

By the aid of fossils collected from the Trenton limestone, I was enabled, fifteen years ago, to connect the lowest limestone of the State of Ohio, with this rock; and also the mass which forms the upper part of the cliff at Frankfort, Kentucky, and of the bluff at Nashville, Tennessee; under which, in both the latter places, is well characterized birdseye limestone.

The dark-colored limestone, as it appears at Trenton falls, or in other words, the well-characterized Trenton limestone in all respects, rests immediately upon the calciferous sandrock, both at the falls back of Spraker's basin, and Canajoharie creek; but at Fort-Plain, Comstock's quarry west of Little-Falls, and at many other localities, it rests upon the birdseye, and without the slightest intermixture of the two rocks. At Fort-Plain, the surface of the upper layer of the birdseye is in parts covered with the fossils of the Trenton rock, not one of which appear below that surface. This fact shows a lapse of time between the two deposits at these latter localities, during which time the rock of the quarry to the southeast of Amsterdam, of that at Tripes hill, and at Sage & Reed's quarry on the south side of the river, and the upper layers of the lower cliff on Black river, were formed, uniting the two by intermediate characters. From the intermediate mass between the birdseye and the Trenton limestone being invariably associated geographically with the birdseye along the whole course of Black river through Lewis county, etc., it was described with that rock; exhibiting more of the mineral character of the latter rock, the fossils being those of the Trenton limestone.

The Trenton limestone is confined entirely to the counties of Montgomery, Herkimer, Oneida and Lewis. Along the Mohawk, it is a rock of uplift; and with the exception of the Noses, it is not found further south of the river than about a mile. The last place where it appears in the Mohawk valley, is on the south side of the river, about three miles west of Little-Falls. The limestone is not found to the west of Lansing's kill; it makes its appearance at the mouth of Wells' brook, and continues up the Mohawk to the kill, and thence to Boonville, the kill being its extreme western boundary in Oneida county. It forms the second terrace of the west side of Black river, ranging parallel with the river; its surface from two to four miles wide, curving from the river in entering Jefferson county. The greatest extent of exposed surface of this rock is in Lewis county; the next extent of exposed mass is in Oneida, being the continuation of the surface in Lewis, from whence it extends into Herkimer, covering the greater part of the town of Russia, and a considerable portion of Norway. It forms, in these two last counties, the dividing line between the Primary and the New-York systems, ranging by the side of the primary; the junction usually concealed by sand and other alluvial products, these latter having been abundantly deposited, and heaped upon the surface of the limestone.

The greatest thickness of the Trenton limestone is in Lewis county, toward the northern end, where it cannot be less than three hundred feet. It diminishes in thickness going east and south, rarely exceeding thirty feet in any part of the Mohawk valley: it is not so thick at the east as at the west end. The dark-colored mass in thin layers, separated by slate or shale, is the kind which is met with in the Mohawk valley, and throughout Montgomery county. In Lewis county, the upper layers are thicker, but often much intermixed with shale, the limestone often in accretions, giving a rough character to the rock, and detracting greatly from its value for all economical purposes, excepting for soil when decomposed.

The grey variety of limestone does not appear upon the Mohawk, nor in Montgomery county, but it is abundant in the neighborhood of Holland Patent, the waters of Beaver meadow, Trenton falls, Cincinnati creek, and the road thence to Boonville. In many parts of Lewis county, the limestone shows a crystalline grain, and the color of portions of it is inclined to be grey. Where so much of the rock is exposed as in that county, and of such great thickness, there must be localities yielding as good a quality of stone as in Oneida county. The upper layers at Rathbone's, near Newport on West Canada creek, are of a grey color, but rather of a fine-grained structure. The grey limestone, from often being in thick layers, tough and solid, is a highly durable and valuable building material, as well as a good marble for finer work.

There are but few kinds of fossil shells associated with the grey variety, nor are the individuals usually numerous. The *Little-eared delthyris* (D. microptera), and the *Deltoid delthyris* are those usually met with, besides fragments of encrinal stems.

It is evident from a slight examination of the geological map of Montgomery, that the Utica slate once extended from the primary to the river, covering the whole of the trenton and the calciferous group of the county, the three masses being originally coëxtensive with each other. From uplifts and denudation, more than half of the slate has been removed from the surface of that part of the county, and the whole also of the Trenton limestone beneath, with the exception of a few insulated partial masses or patches. These masses occur in Broadalbin, Mayfield, Amsterdam, Tripes hill, to the east of Fonda, to the north of Ephratah village, to the southwest of that village also, east by north of Fort-Plain, the creek at Palatine church, and Crumb creek. It may be necessary to state, however, that in this number a few are included which are still in connection with the slate.

From the fact of the Calciferous group, the Trenton limestone and the Utica slate being coëxtensive with each other, it is obvious, that on the south side of the calciferous, and on its west side where it joins the Utica slate, in consequence of the uplift being from east to west, the Trenton limestone will also there be found, as well as the two intervening ones, the base of the trenton and the birdseye, should such have been deposited, these latter rocks not existing coëxtensively with the others ; a fact which may yet be of some practical consequence to those parts of the country.

The quarries and other localities to the south of the calciferous, and south of the Mohawk river, are illustrative of the fact, and show us where to seek for the masses between the calciferous group and the slate. The two first are those of Port-Jackson, and Sage & Reed's, both of which belong to the base of the trenton; the Trenton limestone proper is only seen in small quantity at the latter locality, from the little space yet uncovered.

The first of the Trenton limestone proper that was seen going west, of any thickness of note, is at the Noses, resting immediately upon the Calciferous group, which is well observed at the falls of the creek back of Spraker's basin; also at the dam of Canajoharie creek; at Fort-Plain, on both sides of the creek; at the quarry opposite to St. Johnsville; at Manheim ferry; in Herkimer county, at the top of the uplift, south of the river and village of Little-Falls; and at Parmlee's quarry to the west of the falls, being the terminal part of its range. The localities enumerated are but the points where the rock is exposed along its most southern line in the district; the intermediate ones being covered with soil and other loose materials, the limestone existing coëxtensively with the lower rock, on the south sides of the uplifts, where the river has cut its passage through them.

On the west sides of the uplifts, where the calciferous is exposed over such large surfaces, it was seen but in a few places, being covered by alluvion and soil, and no particular examination having been made for it. That it must exist there, is certain, from its continuousness every where else, and from finding it on the west side of the Noses, and in the same position on the west side of Little-Falls to the north of the river.

The Trenton limestone has been uncovered to a considerable extent along the southwestern boundary of the primary. In Herkimer county, it covers a large portion of Norway, all but a fraction of Russia, and that part of Ohio which borders at the southwest on the two former towns. In Oneida county, it forms a continuous surface with Herkimer, and extends along the primary, averaging about three miles in breadth, and passing into Lewis county. Where it joins to Herkimer, its breadth increases, extending up to Stittsville and Holland patent, and into the valley of Beaver meadow as far as the mouth of Wells' brook, where it disappears under the Utica slate, but soon reäppears on the Mohawk. In Lewis county, it ranges nearly parallel with Black river, curving west in conformity to all the exposed rocks of that section. It forms a continuous mass in the three counties; that is to say, in all its course there, its surface, except on the south and west sides, is not covered by any other products than those of soil and alluvion.

Where the rock is thin, the dark color prevails; where it is thick, the lower parts retain the same kind of dark and thin layers, but the upper are often thick and of a light color. Layers of the latter kind occur in the valley at Holland patent and Stittsville, on the waters of Beaver meadow, at Trenton falls, along Cincinnati creek, and in numerous points where the Trenton limestone is exposed through Oneida and Lewis counties, but none were noticed so pure and solid as those of the first named places.

Where the road which leads to Prospect leaves the one from Trenton village to Boonville, there is quite a novel exhibition, the water of the creek appearing in streams by the joints and other openings in the limestone which forms the bottom of the Cincinnati creek; above the bridge, the water is seen entering the creek; higher up, the whole stream is deserted, presenting a rock surface, under which, and by the joints of the rock, the water courses by its subterranean route to where it reäppears near the bridge.

From the facts here presented, the origin of the Natural bridge in Virginia is readily understood. The bridge crosses a narrow deep limestone valley, like that of Trenton falls; the bridge being a part of the original rock which filled the valley, all the other parts having been removed by the same cause now acting in Cincinnati creek, and in the same manner. The rock there belongs to the same system, and is nearly of the same age with the trenton. The latter rock shows from one to three vertical joints; but in all rocks, the number varies in a given space: as a general rule, they are fewer where the layers are thickest. All, therefore, that it is necessary to conceive, in order that a bridge of the kind should be formed, is that water should flow as at the Cincinnati creek; that a part connected with the sides, and near the surface as in Virginia, should be more solid than the other parts where the water flows; and finally, that all should be removed but the solid portion, leaving an excavation like that of Trenton falls.

The grey limestone is quarried at Cincinnati creek as a marble, and burnt also for lime; it is also quarried in many places in Holland patent, Beaver meadow, &c.

The vertical joints in the Trenton limestone are generally two in number. In Martinsburgh, at the lead mines, one is N.W., and the other varies from E. ½ E.N.E. to E. ½ E.S.E.; at Copenhagen, one is N.E., and the other N.W. Two of the joints are nearly at right angles to each other, a third is oblique to the two, and one of the three is often absent.

The Trenton limestone is an important rock to show the ancient level of all the points where its surface now appears, extending without interruption from East Canada creek to the St. Lawrence river. Its calcareous composition shows that it was a precipitate; the shale with which its layers so often alternate, prove that it was deposited in tranquil waters, and its flat layers confirm the original horizontal position of its surface.

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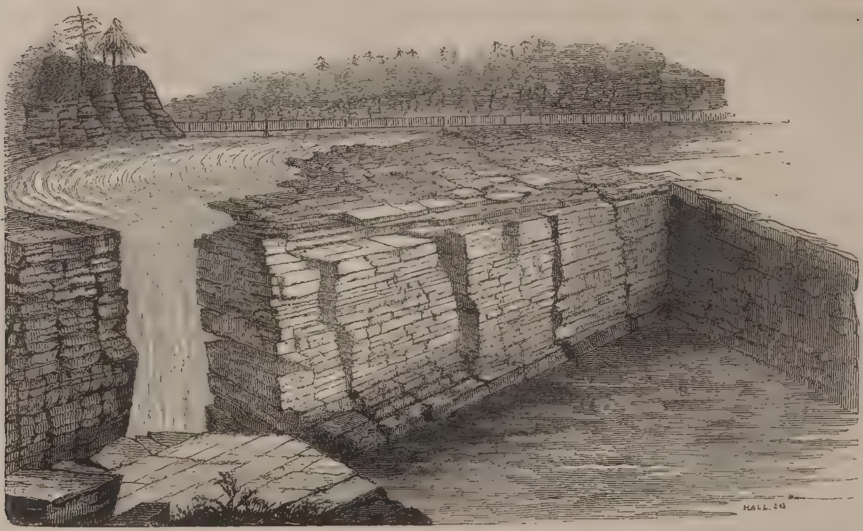

View of the Falls below the Foot-bridge, from a Drawing of R. C. Taylor.

The character of the Trenton limestone as a rock, showing its horizontal layers as they appear transverse to the stream, and its well-characterized vertical joints, is well exhibited in the wood-cut No. 5, taken at one of the falls of Trenton, on West Canada creek. The most interesting locality of the Trenton limestone is on this creek. For about two miles, the creek has cut a passage through the limestone; the sides of the excavation rising vertically, with an average height of over one hundred feet. In this passage are the falls or cascades which have given so much celebrity to the place, justly meriting by their number, beauty and position, the admiration which they have received. Including the one at Prospect village, there are six falls, five of which are placed at intervals somewhat regular, and occupy the middle part of this time-wrought excavation. The layers generally thoughout this distance, with the exception of the grey variety which forms the upper part of the mass, rarely exceed a foot in thickness, are usually from four to six or ten inches, and separated by more or less shale, the whole of a dark or black color. The layers dip at a very perceptible angle with the stream, the course of which is a little to the west of south, some of the layers appearing to play more than one part at the falls.

There can be no doubt that the whole of this passage has been caused by the action of water and frost, no trace of a fault being visible in any part of its course, which could readily be perceived at the mill where the excavation ends, or at any of the falls, when the water is low, if any existed. There are evidences of local disturbances, but they are trifling in comparison with the vast mass of the rock in which nothing of the kind exists. The great facility afforded to the water of the creek in making this channel, was the double system of joints in the rock at nearly right angles to each other, and the shale which usually separates its layers. There is a third system of joints, but it is a partial one. It is by operating upon these joints, of which few rocks are destitute, that water and frost are enabled to exert their great power. Though the quantity of water which passes by the falls be very considerable, it must be small in comparison with the volume or body which once had its outlet in that direction; so prodigiously great is the amount of alluvion which is heaped upon the surface of the rock, facing its banks above Prospect, and from that village, to Trenton village.

There are some very limited local disturbances to be seen near the "Great falls," which merit notice. The first is on the west side, and below the falls. For thirty or more feet in length, and from three to five feet in thickness, the rock exhibits extraordinary contortions for one whose layers are so regularly disposed, forming almost semicircular curvatures, and not unlike the writhings of a huge serpent. Though the disturbance is so great within the limits given, yet the layers above and below are wholly unaffected by it. When the contortions are examined, they show a crystallized white limestone, enveloped in the usual calcareous shaly materials, proving that the disturbance was caused by the crystallization of the white limestone forming a layer; which, for want of room to expand, this effect being simultaneous with the action as in the freezing of water, was forced to recoil, and thus to form the contortions noticed. It is not unlikely that the water of the mud from whence the shale was produced, was the solvent of the calcareous particles, enabling them to assume the crystalline state. At one of the extremities of the contorted rock, where it joins the undisturbed portion, it is broken into fragments, some of which are turned on end from the violence of the action.

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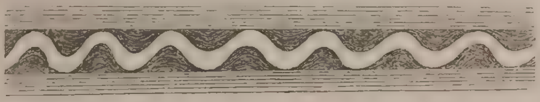

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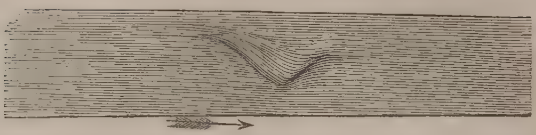


On the opposite side of the creek, there is a disturbance equally as limited as the preceding. It is at some height above the water. The layers appear to have been bent downwards, and pushed outwards, or toward the stream; of which the wood-cut will give an idea.

These instances of disturbance in rocks are cited, because they are wholly local, and show that some parts may be greatly disturbed, whilst contiguous ones remain totally unaffected. The former instance is of importance, because it throws light upon myriads of similar appearances in the primary class of rocks, and in gneiss and mica slate particularly. Where such minerals as quartz and feldspar, with but little mica, or any other mineral in like amount, form rocks, they show but little tendency, as a general rule, to form layers or other like divisions, and hence such rocks are termed unstratified; but where mica or talc forms an important part of the mass, the disposition in layers occurs. These are straight or waved, curved or contorted, and the latter often to so great a degree as to exemplify an angular movement. It would appear, that where desiccation and crystallization had been simultaneous, the result would be a plane surface, the acting forces being supposed equal; but that where the contorted and angular appearances occur, the nucleus being usually quartz and feldspar, these have been the active powers, commencing first to crystallize, and the mica or other lamellar mineral the passive one, as exemplified by the two substances which form the contorted mass at the Great falls.

The village of Prospect is on the alluvion resting upon the Trenton limestone, which there forms the surface rock; being at the head of the falls, and but a short distance to the west of the excavation. The present direction or channel of West Canada creek is but one of many which it has had, the last of which was through the site of the village, passing south, and parallel to the present one.

At Prospect bridge there are some local disturbances in the rock, which may have facilitated the first movements of the water in making its present deep channel. In examining the layers of which the sides of the excavation are formed, we perceive that the lower the layer near the bottom of the channel or passage, the greater is its inclination, dipping down the stream; and the higher the layer, the less the inclination. Just below the bridge, the layers rise again by a low but graceful undulation, and then resume the usual inclination which they show throughout the excavation. Should the lower inclined layers have extended to the surface north of the bridge, and with the same or a lesser angle, which is likely to have been the case, then their position would have greatly aided the destructive forces; and when once the course of the water was fixed, its movement, from the dip of the rock, would be greatly increased.

The falls of Trenton are not only the best locality in the district, as to the mineral character of the rock, but are equally so for the fossil one; and being the only rock there, the name of *Trenton limestone* is unexceptionable. This is what is required for every other rock, and the same principle ought to be carried out for groups, systems or classes. This would give two ideas for one word, fixed points for comparison, and certainty and simplicity to the whole subject. So, also, the specific names of all fossils should be based upon the same principle; and if carried out fully, as it should be, the subject would be of ready acquisition to every one.

The whole of the fossils, by which this rock is readily recognized, exist at the falls, and some in prodigious numbers; such as the Alternate strophomena, Tortoise orthis, Open bellerophon and Puffball favosite. Those which are in less number, are parts of Senior calymene, Striated orthocera, etc.

Among the many localities of note where particular fossils are found, a few only will be mentioned. One is Mr. Rathbone's, on the west side of West Canada creek, just above Newport. This is the place from whence the *Calymene blumenbachii*, or *Calymene senaria* of Mr. Conrad, was obtained, and sent to M. Brongniart at Paris; and which, from similarity of name, was supposed by the geologist of Massachusetts to be *Newport, Rhode-Island.* It is one of the two known localities of the *Trocholithus ammonius* of the same author, and which was first discovered by Gen. Spinner. The Striated orthoceras, the Trenton lingula, and the more common fossils, are in considerable number at this place.

*Moltona creek*, between Middleville and Fairfield village, is also a good locality: more rock is exposed, and the fossils are more numerous and rather better preserved. This is one of the best localities for fossils of the Trenton limestone. It is the only place where the *Compressed phragmolites* was found, and the best species of the *Quadrasulcated conularia.*

*Sugar river*, near where it disappears between the joints and the lower layers. At the height of about twelve feet from the bed of the river, there are two layers which contain the *Glabrous atrypa* (Atrypa glabella) in considerable numbers; and also fine specimens of the *Semioval strophomena*, with other well preserved fossils.

*Fort-Plain.* More fragments of the Giant isotelus were seen here than at any other locality: it is interesting also from the junction of its limestone with the birdseye limestone, as already noticed.

The Trenton limestone is the most metalliferous rock in the district, as regards lead and zinc ores, but neither are found as yet in profitable quantity. The most favorable locality is near Martinsburgh in Lewis county, about half a mile to the northwest of the village. The surface of the rock is but slightly covered with soil, showing numerous vertical joints, chiefly in two general directions; one N.W., and the other varying from E. ½ E.N.E. to E. ½ E.S.E. In these latter, or the east and west joints, the ore is found, consisting of sulphuret of lead, sulphuret of zinc, oxide of zinc, and some little copper pyrites. There are several parallel workings, one of which extends about two hundred feet along the surface, and the deepest about fifty feet, being not more than a sixth-part of the thickness of the rock.

It would be an easy matter to form a correct opinion of the value of this deposit from its superficial workings, were an equal distribution of ore to exist throughout the mass: these showed that the ore obtained would not pay expenses; but should the opinion be correct, that the source of all metallic deposits is below the rock in which they are found, then the nearer the source, the greater the probable quantity, and the upper workings would not be a good guide. So also by the view adopted, the materials having been derived from the rock by the attraction of the walls of the mass formed by the cracks or joints, or by ordinary transudation, the particles collecting in the fissures, and there taking or assuming those states in which we find them, then no correct opinion could be given, knowing nothing from other mines of an equal distribution of ore in any vein or deposit of the kind. Mining is and has always been a lottery, but a highly useful one for those who have ample means, and love the excitement which springs from unexpected turns of fortune, or the chances of gain from mere possibilities and probabilities, and who must have a vent of the kind.

## 5. UTICA SLATE.

*Black Slate or Shale. Fairfield Slate of the Reports. Greywacke, or Metalliferous Greywacke of Eaton.*

(No. 3. PENNSYLVANIA SURVEY.)

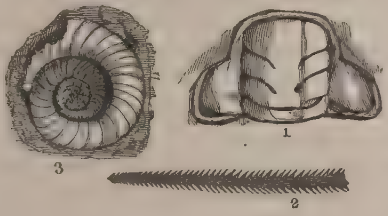
This rock, when unaltered, is of a deep bluish black, generally fissile, exhibiting a brownish or dark chocolate-color by alteration or long exposure to the weather, and producing by decomposition a tenaceous clayey and highly favorable soil for grass, forming the best dairy land of the district. It is associated with thin beds of the same kind of colored impure limestone, which are usually found in the lower part of the mass. These beds are from one to five inches in thickness, the greater number of them being fitted for flagging, and of good quality. The slate often presents thin veins of white lamellar carbonate of lime, of a line or more in width.

The Utica slate contains no fragments whatever of other rocks. It is the same material mineralogically, which separates the dark-colored layers of the Trenton limestone. The two masses were coëxtensive deposits in the district, the material of the Trenton limestone ceasing to be deposited long before the deposition of the slate ceased; the latter often showing a thickness whose maximum is about two hundred and fifty feet, the whole of it resting upon the Trenton limestone, and upon no other rock.

With the appearance of this rock, the greater number of the Trenton limestone fossils ceased. Those which are found in common to the two, are Tortoise orthis, Alternating strophomena, Oval lingula, Puffball favosite, Giant isotelus, Senior calymene, Dentated graptolite. This latter fossil is rare in the limestone, but is exceedingly abundant in the slate. The whole are confined chiefly to the lower part of the rock, the upper part being non-fossiliferous.

The fossils which are found in this rock, and which have not been seen in the Trenton limestone, or in any lower position, are the following:

8.



No. 1. *Beck's triarthus* (Triarthus beckii), the head of which, from its frequent occurrence in the slate without its body, is the reason why it alone is figured; but the entire animal will appear in the Report on the fossils of the State. It is the characteristic fossil of this slate, existing in great numbers in some localities; but it is not exclusively confined to this rock, a few heads having been seen towards the upper part of the Frankfort slate.

No. 2. *Dentated graptolite* (Graptolites dentatus), is in great abundance: very few localities are destitute of it. To this fossil, in all probability, the slate owes its dark color, which is due to the carbonaceous matter composing the fossil. This species extends into the rock above, unless there be a difference, which is yet to be determined.

No. 3. *Utica trocholite*, should it be different from the Trocholithus ammonius of the Trenton limestone. It is in greater number on East Canada creek, just above Manheim bridge. It is usually compressed, and about the size of the ammonius. The one figured is smaller, rather less than half the usual size, being about one inch in diameter, and apparently a young individual. It was found on Canajoharie creek.

A long slender orthoceras is frequently found in the slate; it resembles the *Striated orthoceras* of the Trenton rock.

The *Ladder graptolite*, (Graptolites scalaris), has been seen in this slate, but it is a rare species; a few specimens only have been found, none of which could be obtained in time to be executed in wood. It is well named, consisting of two elongated parts, connected by cross bars placed at regular distances.

The Triarthus beckii, as before asserted, is a very constant associate of this slate, but it is rare to meet with more than the head or fragments of the body and tail of this animal. The best locality, and where numbers of perfect ones have been found, is at the old mill-dam, below the junction of Oxtungo creek, about four miles south of Fort-Plain. The first ever discovered that were perfect, was in the creek to the east of Utica. A few have been found on East and West Canada creeks, but are rare, though the heads are rather numerous; the easy solution of the ligament which binds the crustaceous parts, being probably the cause why so few comparatively are found whole.

Out of this rock, in the district, I have met with but one head, and this was in the Frankfort slate, in the gulf to the east of Utica. It was very small, not more than half the usual size, resembling those found opposite to Cincinnati, Ohio, as seen in the collection of Mr. Conrad.

This rock is confined entirely to Montgomery, Herkimer, Oneida and Lewis counties. It enters from Schenectady county, on the south side of the Mohawk, and extends without interruption, excepting along the border of the river from uplifts, to about Whitesborough; there it crosses the river, and extends north through Lewis into Jefferson county. As this rock in the district invariably rests upon the Trenton limestone, so the Frankfort slate and its sandstone follow the Utica slate. Knowing the order of their succession, when either of the two are discovered, the other is readily found; and a similar remark applies to all rocks which are coëxtensive masses, or which coëxist in any one or more localities.

On the north side of the Mohawk, the slate covers the large area extending from near Tripes hill to the uplift of the Noses, and north to near the Primary region, forming that fine section of country in which Johnstown is seated. It covers also the area west of that uplift, extending to near Mother creek. These areas show less transported materials than any other observed, the soil which covers the slate being generally the product of the slate. The cliffs along the water courses are of no great height in the Johnstown area, but rise a hundred feet on the Garoga. A small patch was observed in Broadalbin and three in Oppenheim, one of which is at St. Johnsville, another at the mouth of East Canada creek, and the third on Little Sprite creek, extending from East Canada creek. To the south of the river, it covers nearly one-half of the county on that side, ranging somewhat parallel with the river, extending south from the river, and passing under the Frankfort slate and rubblestone.

In Herkimer, it covers the greater part of the space, with some few exceptions, which extends from East to West Canada creek, and from the Mohawk to Norway. The soil of a very considerable portion of the space it covers, shows that it was produced from the slate. West of the creek, it covers the whole of the area formed by the creek, the river, and the county line of Oneida, with the exception of the top of Hasenclever hill, which consists of the Frankfort slate.

In Oneida, it passes under the city of Utica, appearing in the creek to the east of the city, whence its name. It covers the greater part of the towns of Deerfield and Floyd; a large portion of Trenton, of Steuben and Western also, and passes into Lewis county towards the middle part of Boonville.

In Lewis county, its range is uninterrupted, rising to the west of the Trenton limestone, and curving north into Jefferson county. Its characters, mineral and fossil, are without change in all its range.

The thickness of the slate is well seen on the south side of the river through Montgomery county, where numerous small streams flow in very deep channels cut into the slate: its maximum is there probably the greatest. Through Steuben and Western are other points where it can readily be examined, and where it shows great thickness. So also in Lewis county, it is still more favorable to observation; the slate forming a part of a high range as in Montgomery, by which numerous water courses traverse to Black river, through very deep channels cut into this rock.

Where the lower part of the slate appears, in Herkimer county especially, the thin layers or flags of impure black limestone, so characteristic of it, may be observed. They are best seen on West Canada creek, towards the lower part in its small tributaries, and in the side-hill on the south of the river below Herkimer village. They are more exposed near the farm of Stephen Hammond, to the north of Little-Falls, not far from the road to Fairfield.

At this locality, in a small lateral water course, there are two thin layers of fibrous sulphate of strontian, which are parallel with the slate; also a singular layer, two or three inches thick, of a leaden grey color, resembling clay, but solid: when wet with water, it falls into fragments like lime in slaking.

The slate shows at every point two sets of vertical joints, and often a third. At the creek to the east of Utica, the direction is N. 30° E. for one, N. 55° E. for another, and S. 60° E. for the third; this latter is the less common one. South of Little-Falls the joints were N. 89° E., and N. 19° E.; at the brook on the south side of St. Johnsville, N. 55° E., and N. 15° E.; near the dyke on East Canada creek, N. 30° E., and S. 70° E.

Back of Spraker's basin, where the slate makes its appearance in the bed of the creek about half a mile above the falls, there are several small workings for lead ore. No large regular veins exist, but only the common vertical joints of the rock filled with carbonate of lime, and some sulphurets of lead, iron and zinc, the latter rare.

The first mine, ascending the creek, is on the left side: there the ore of lead is to be seen; the veins numerous, but none at that time over one and a half inches wide; very irregular, the direction being generally east and west. This mine cannot be very far in perpendicular direction from the Trenton limestone; and should the workings ever be extended to that rock, it may furnish facts conclusive as to the connection between the rock and the substances which fill the veins, though less so, from the similarity of the two rocks in part as to composition, than if they were totally unlike each other.

Higher up the creek, on the same side, is the next working: there the slate rises into high vertical walls on both sides of the creek. This is the point from whence the mass of galena, several inches wide, was taken, and which was sent to the Treasury office. At this mine are veins of brilliant pyrites, and some carbonate of lime, with a little galena. The vein worked is very variable as to width, enlarging from three to five inches within a distance of a few feet, and then nearly running out from the sides of the rock coming together. The veins exist in a part of the rock where the material of the slate was more plastic and carbonaceous than is usual with the rock.

Other workings exist on the opposite side of the creek, and were deemed the most important. Many years ago, workings were made in the bottom of the creek, where innumerable veins or strings of white carbonate of lime exist, showing occasionally a few specks of galena.

The whole of the veins are but the east and west joints of the rock, where the conditions for the secretion of their contents existed. They are of great importance as to the true theory of veins, but of none whatever in an economical point of view; the rock being expensive to work, and requiring to be very rich in order to compete with the "lead diggings" of the west; which, though so far distant, are yet near to cheaply navigable waters; and the ore, being profusely distributed, and often in decomposed or altered rocks or cavities, calls for the use of the spade oftener than the blast; hence the term *lead diggings*, so frequently applied to those deposits.

This slate in the third district forms the surface, through which all the rocks of the uplift have been protruded. It was therefore uncovered to a great extent before that action took place, as is evident from its geographical distribution as it appears upon the geological map.

## 6. HUDSON RIVER GROUP.

*Frankfort Slate and Rubblestone, Green Slate and ditto of the Reports, with the Shales of Pulaski. Greywacke, or Metalliferous Greywacke of Eaton.*

(No. 3. Pennsylvania Survey.)

This group consists of the Frankfort slate and sandstone, and the sandstone shale of Pulaski, or shales and sandstone of that place; the former name generally being more appropriate, as it contains more sand than shale, or what was mud or fine earthy sediment. The group rests upon the Utica slate throughout the district, and is next in order as to age. It is followed by the grey sandstone of Oswego, the rock which immediately succeeds to it in the district where that rock exists.

The name is adopted as being generally used in the survey, and as being more comprehensive than the one heretofore used. It is, however, objectionable, from the difficulty of defining its limits along the region of the Hudson river; from the disturbed and altered state of the greater part of its rocks; from the absence of those which immediately precede and follow it, and which show its position in the class; and from the difficulty of separating or distinguishing the slaty or schistose members of the group, from those of greater age with which, on their eastern border, the two are more or less really or apparently blended. These objections are of no small import. The difficulty of the subject has led other geologists into error, besides those of our country. There is now every reason to believe, that the facts in relation to this group, leaving out the Pulaski portion, are the same in England as in the eastern part of New-York; that the group in England overlaps the lower rocks, extending toward the primary, which there is to the west and not to the east, their relative position being reversed; and exhibits the same derangement, the same alteration of character, and the same apparent mixture with more ancient schistose rocks, as in New-York. It is very certain also that no line of division, either fossil, mineral or of a stratigraphical character, can be drawn between the Silurian and Cambrian systems, as they are presented to us in England. Not that there is not a system below the Silurian, for such there must be, from the facts in New-York and elsewhere observed; but the subject is there observed by the protean character of the Hudson river group, just as we find it to be in the United States, when near the long line of the primary, its layers or parts are disturbed as an overlapping rock.

In Schoharie county, the Hudson group is undisturbed and unaltered, and its maximum thickness is not less than seven hundred feet; but from the absence of the succeeding rock, its precise position is not made known. Further west in the third district, the whole series is complete, and its position well defined. There no mineral line of division exists between the Hudson group and the Utica slate beneath, nor the grey sandstone which rests upon the group; but the host of fossils with which the upper part of the group is loaded, totally cease with the group; few or scarcely any of them appear in the grey, and none whatever in the redsandstone, the next in succession to the grey. The upper part therefore of the group, the sandstone shale of Pulaski, from its well defined fossil character, becomes a good line of division to distinguish the Hudson group from the succeeding rocks, and from this circumstance is used as a boundary line.

This group is one of the universal ones. It is the one to which the name of *grauwacke* was originally applied, and when but a few rocks of the class were known. Subsequent discoveries of other argillaceous and arenaceous rocks in the same class, each of which received the same name, finally created so much confusion as to require that the name should be laid aside.

The two divisions of the group are not coëxtensive with each other; the lower one enters from the first district along the Mohawk, and extends north by Rome through Lewis into Jefferson county. The upper division first appears in Oneida county, and from thence west and north, is a coässociate of the Frankfort slate, or lower division. The two divisions, as in the former reports, will be treated separately, inclining to the opinion that they ought not to be put together in local geology.

Though the Frankfort slate changes by imperceptible gradation from the Utica slate, being coässociates, yet a separation would seem obvious from the fact that the dark blue or black color of the latter disappears in the usually light color of the former. The Utica slate alternates at its lower part with thin beds of dark-colored impure limestone, and is connected by alternation and by organic remains with the Trenton limestone, and presents generally in the district a thickness of two hundred feet. The Frankfort slate, on the contrary, alternates with a peculiar sandstone to which Professor Eaton gave the name of *rubblestone*. The slate is wholly destitute of calcareous particles, and its great thickness in the first district, though it diminishes going west and north, entitles it to a distinct appellation. It is an important rock in Europe; in this State; in Pennsylvania, and the States to the south. It is the source of the springs of Saratoga and Ballston; the mineral springs from boring, both of Albany and Hampton, and the springs at Saltspringville. It is the lowest rock of New-York which contains brine springs, and from which salt, it is said, has been manufactured.

The rubblestone which forms thick masses in the first district, is but in thin layers in the third district, excepting probably in Montgomery county, where it is abundant upon the surface as weathered masses, and may have originated there. It forms generally the enclosures of the fields at the east end of the county, and within the range of the slate. Both slate and rubblestone lose their bluish color when long exposed, and assume a dull dark grey, green or olive color, which is very characteristic of this rock, and by which it is readily distinguished from the Utica slate, which, as before mentioned, changes to a brown.

From the eastern end of the Helderberg to Oneida county, I have seen but one fossil shell in the whole mass. Graptolites, however, occur, and in a few places are numerous. In Oneida, shells, etc. make their appearance in the upper part of the mass, and with propriety are to be referred to the upper division, from the well known fact, that throughout the whole eastern border of the range of the slate, with the exception of two localities, it is equally barren of organic bodies other than graptolites.

The Frankfort slate, and its sandstone, are confined to the counties of Montgomery, Herkimer, Oneida and Lewis. In the first county, the rock is entirely to the south of the Mohawk, and to the south also of every part of the Utica slate. In Herkimer it lies also on the south side of the river, and to the south of the Utica slate, with the exception of one locality to the north, capping Hasenclever hill, extending west from near West Canada creek into Oneida, ranging with the Mohawk, and covering a surface from three to four miles wide. In Oneida, it is on the south side of the Mohawk, its breadth increasing west, ranging along the river from about Whitesborough, which finally it crosses, keeping on the east side of Rome, passing north to the west of Lansing's kill into Lewis county, keeping the west side of Constableville, and thence through the county in a north-northwest direction. In Oneida, besides the great range, it appears at three other points. The first one is the extension of Hasenclever hill, which continues towards Nine-mile creek; the second, covers an area of a few miles to the west of the village of Floyd; and the third, a similar area in Steuben, where it caps the highest points of that town.

Through Montgomery, Herkimer, and the east part of Oneida, the slate constantly rises from the river, presenting, in some parts of its range on the south side, deep excavations from falls where it is covered with overlying rocks. Its points of greatest interest are along this line. The first place of note on the south side of its range near to the first district, is at Saltspringville: it underlies the level, appearing at the mill race, and by the side of the road which leads to Cooperstown. It is there of a blackish color, traversed by joints in several directions, and crumbles or falls into fragments by exposure to air and moisture. It is from this rock that the springs issue, which have given name to the village. For near half a mile, indications of salt water are perceived at several points, by the absence of vegetation. At one of them, a well of about twenty feet deep was sunk, and salt water obtained. A tradition exists that salt was made at these springs before the Revolution, and in sufficient quantity to supply the inhabitants; that from two kettles of five pails each, three pecks of salt were made in a day. Saltspringville is on the road from Fort-Plain to Cooperstown, and near the line of the two counties.

To the west, at the lower mill below Vanhornsville, and also at Yawheiur creek to the east of Mr. Shawl's, the water falls over the conglomerate and the slate, into the deep gulfs excavated in the slate by the waters of the creeks. At the mill, numerous graptolites, the G. * * * *, exist in the slate at the top of the mass, which was uncovered in making its foundation. Thin layers of sandstone in alternation with the slate, being a common character of the mass, appear in the gulf; towards the bottom of which, near the depth of one hundred feet, it is more coarse, and there assumes the character of the thick layers in Schoharie.

The points further west, where the slate also passes under the overlying rocks, enumerating them in their geographical order, are first, by the side of Wicks' store, in the brook, which exhibits but a small excavation in the slate; in Fulmer valley, it shows itself in many points, the greater part of the valley consisting of the slate; in Steel's creek and Myers' creek back of Frankfort, whence the name given in the second year of the survey. The latter creek affords the best opportunity for observing the edges of the slate, which extend like a wall for two miles up the creek. It shows thin layers of sandstone, at variable distances from each other, separated by slate. A good point also is at Starch-factory creek, and another at the hill which projects north between the creek and Utica; and a still better one presents itself in the long and deep gulf to the south of the Minden turnpike, the entrance to which faces the southeast end of the city. Its whole length and depth is excavated in the slate, which disappears under the Oneida conglomerate, over which the water falls at the head of the gulf. The mass in the gulf consists of slate, and sandstone slate, none but very thin layers being observed. Towards the upper part of the slate, the Cryptolithus and the Triarthus were found, the latter not more than one-third of the usual size; and also two or three thin bivalves, quite small, not yet described, figured or named. These fossils appeared to be rare; and from their small size, could readily have been passed unnoticed. Only one specimen of the Triarthus was found, and but two of the Cryptolithus.

The last place to the south of the Mohawk, where the Frankfort slate appears in the hillside, is under the conglomerate on the farm of Mr. Mason, on the hill to the east of New-Hartford Centre.

North of the Mohawk, it covers the high hill which extends through the towns of Schuyler and Deerfield, surrounded by Utica slate in all directions. The range which turns north from the Mohawk, shows itself at Ridge's mill to the north of Rome, and in some of the small streams which flow east into the Mohawk and its east branch, Lansing-kill. Through Oneida and Lewis counties, its range is undisturbed; it presents no change of character, and appears in all the water-courses of the latter county which flow east, over the limestone, to the river.

The Frankfort slate and sandstone, though so thick a mass, and placed between two such highly fossiliferous rocks as the Trenton limestone and the sandstone shale of Pulaski, is remarkably deficient in organic remains, excepting in graptolites. In the third district they are, however, but few in number when compared with the first district; there they exist in great number, in excellent preservation, showing from four to five species, and are found in many localities. The illustration of this rock by its graptolites is therefore left for the geologist of that district. We shall merely state that the ramose nature of two of the species of these singular bodies, as found at Alexander's bridge below Schenectady, at Normans-kill below Albany, and at Hudson city, shows that their origin was vegetable, and not animal, as conjectured by some naturalists. Their chemical composition confirms their vegetable nature; no animal ever existing whose material was almost entirely carbon, as is the case with these fossils.

*Shales of Pulaski of former reports, the upper division of the Hudson river group.* The sandstone shale of Pulaski, or fossiliferous portion, is the second or upper division of the Hudson river group. As respects its fossil history, it will probably be subdivided, from the following facts:

In the report of 1840, it was said, that "Fossils are rare in the lower part of the Frankfort slate, but are numerous where it joins the next series, the Pulaski shales. To which of these two masses they belong, or if they form a separate mass, has not been determined; but that they are important geological lines of division is certain, for there is no essential difference between the fossils, whether seen at the mill race at Lee Centre, or Whitall's quarry near Rome, at Halleck's spring in Hampton, or the gully near Utica, and the Cohoes near Waterford. In all these localities, the group of shells which so peculiarly characterize the Pulaski shales are wanting, and others appear that had no previous existence in the district;" among which is the *Dolphin-head trimerus* (Trimerus delphinocephalus), the *Hampton pentacrinite* (Pentacrinites hamptonii), and some others which reäppear from the Trenton limestone.

This part or subdivision is uncovered for some extent to the south and west of Rome, and occupies the intermediate area to the Frankfort slate proper, and the rocks of Pulaski village, separating the two. In mineral character, there is identity between the lower subdivision and the Frankfort slate; whereas the upper or Pulaski part partakes of the same character, and of the grey sandstone likewise, thus mineralogically uniting the two. The upper portion furnishes some good building stone, the lower none of much consequence. That the separation into two portions is not accidental, appears evident from the existence of the lower portion between the Highlands and Newburgh without the upper portion.

*Sandstone shale of Pulaski,* called the *Shales of Salmon river,* and *Pulaski shales;* the name being changed in order better to express its mineral nature, being a mixture of sandstone and shale, the former generally preponderating at the upper, and the latter at the lower part of the mass. It is the only rock at Pulaski village in Oswego, and for some distance around. It will therefore serve as a type for the name, for with none other can this well-defined mass be confounded.

The fossils by which these shales are readily recognized, are, No. 1 of the wood-cut, the *Carinate pterinea,* (Pterinea carinata); No. 2, *Ornate cyrtolite,* (Cyrtolites ornatus); No. 3, disk of the *Hampton pentacrinite,* (Pentacrinites hamptonii), from the town of Hampton, where first discovered.

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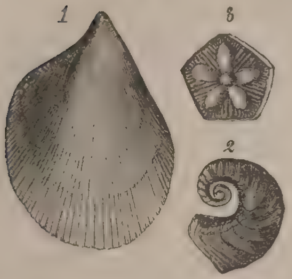

There are many other fossils, also, which exclusively belong to this rock, some of which are equally characteristic; such as the *Modiolar cypricardite* (Cypricardites modiolaris), the *Narrow-front cypricardite* (C. angustifrons), the *Nasal cypricardite* (C. nasuta), the *Ovate cypricardite* (C. ovata), the *Curtate cypricardite* (C. curta), the *Pholade orthonata* (O. pholadis), and some others not yet described, among which is an orthoceras highly characteristic of this rock.*

Besides these fossils, there are others which belong also to the Trenton limestone, but which do not appear in the Frankfort slate or rubblestone either in the district or in the counties of Schenectady or Schoharie, though the mass is of such great thickness in those two counties, exceeding five hundred feet. This mass appears to thin out to the west, by which means the longer-lived races were enabled to continue their existence, or rather extend their range from the lower to the higher rock. The fossils which reäppear, as it were, in the district, are the Semioval strophomena, Alternate strophomena, Tortoise orthis and Senior calymene. Besides these, there are two others of which doubts exist as to identity, the individuals of both very numerous in both rocks, the Tessellated cryptolithus and the Open bellerophon. It may be well to state that the Tessellated cryptolithus, which was found in every locality of the sub-mass or lower portion of the upper division, was not often seen in the upper portion.

The mineral character of the division at Pulaski is about the medium one of the district, consisting of dark grey-colored sandstone and bluish shale, the two more or less intermixed with each other. Some portions of both are mixed with carbonate of lime, and also with pyrites; the latter is evidenced on those parts containing calcareous fossils, which for a long time have been exposed to the weather, being more or less stained with iron. The rock forms a low bluff on both sides of the river, its greatest height about twenty-five feet; and continues down the stream for some distance. Above the dam at the village it is uncovered on the north shore, rising but a few feet above the river. Higher up, about a quarter of a mile from the dam, a more sandy and rather lighter colored mass is seen, holding a higher position, evidently the terminal part of the division in that region. This portion abounds in the Alternate strophomena, none of which, in any of the localities where the whole could be seen, was found below that position. The same ferruginous stains also mark the upper portion when greatly altered.

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* The whole of these species of Cypricardites, as well as the Orthonata, were noticed in the annual reports under the generic name of *Pterinea.*

The first locality in the Mohawk valley where the sandstone shale of Pulaski appears, is at Talcott's and Comstock's quarries about two miles to the south of Rome. About ten feet of the mass is exposed, the larger portion of which is good building stone, and is quarried for Rome. It is far more sandy than any of its other localities, and its color is a light grey. It is not in regular or straight layers; the divisions are caused by shale of the usual bluish color, either uniformly spread over the surface of the sandstone, but in patches of no great extent, or irregularly intermixed with it, and sometimes so thin as to be a mere coating. The fossils so characteristic of the division at Pulaski and other localities north and west of the Mohawk, are here extremely abundant; such as the Carinate pterinea, the different species of Cypricardites, the Alternate strophomena, the Ornated cyrtolite, and other testaceous fossils and some fucoids to be noticed in the Report of the fossils of the State.

The Alternate strophomena occupies, as at Pulaski, the highest part of the mass. It is in very thin layers of sandstone, and with the same altered character as at the former place. Fragments of this division of the group are numerous in the enclosures of the field, for some distance from the quarries.

To the west of Rome, extending north through Lewis county, the Pulaski shale covers a large portion of the west side of the range of the Hudson-river group, varying in breadth from four to six and more miles. Throughout its whole range its fragments are numerous, and usually show one or more specimens of its peculiar fossils. Among the many localities where the division may be seen to advantage, is the creek at Taberg village, and at the point of rocks on Fish creek, about seven miles above the village. At the latter place, it forms a bluff about twenty feet high, where two streams meet at an acute angle, and it is also found in the bed of the creek. Its range is rather to the east of the north branch of the Mohawk river, forming a low bank at Preston's saw-mill, and appearing also in a well at Tuttle's farm, to the north-east of the mill.

In Lewis county, no localities were observed of particular note; it ranges to the west of the lower slates, appearing in numerous places along their range, and approaching nearer and nearer, going north, to the line of the Utica slate. On Deer river, about three miles to the west of Copenhagen, the shale and sandstone appears at Adcock's mill, and contains Tortoise orthis, Semioval strophomena, etc. Where the road crosses the river from Rodman to Lowville, seven and a half miles from Copenhagen, the Pterinea and other fossils of Pulaski are seen near the bridge.

The most numerous points where the Pulaski rocks are exposed, are in the northwest part of Oswego county, where it forms the surface rock, and where numerous creeks and other water courses traverse its layers, exposing their surface and edges. Among these are Deer and Little Sandy creeks, the latter being a good point for examination, both at Washingtonville and above the village. In that section there are some fossils which are more numerous there than in other sections, and usually associated together, such as the Semioval strophomena and the Tortoise orthis. These fossils, and a few others, were also found in a similar rock on the Hudson river, to the south of Newburgh, evidently there forming the upper part of the Hudson river group.

Carbonate of lime appears to be rather more abundant in the range of the upper division in Oswego, than in the other counties; thus at Pulaski near the water line, there is a layer highly charged, of about ten inches in thickness.

In the collection of the Academy of Natural Sciences at Philadelphia, there is a specimen of this rock, picked up on the south shore of Lake Erie, which is of interest, from its showing whence it was transported, and from its goodness as a limestone, being purer than any of the kind found in the third district. Its origin is shown by its enveloped fossils, and the olive-colored sandstone which adheres to one of its sides.

The two divisions exist separately in Pennsylvania; the lower one ranges to the east of the Blue mountains in the Kittatinny valley, and is worked for roofing slate on both sides of the Delaware river. The other division, having the same characters in all respects as in New-York, occurs on the edge of Nippenose valley, near the west branch of the Susquehannah.

In Ohio and Indiana, the upper division, with its fossils, exists: the lower one has not yet been observed. It is there highly calcareous, and forms the upper part of the blue limestone of these two States. In those States, the whole, from the Trenton limestone to the sandstone shale of Pulaski, consists of but one rock or mass, according to western observers; a fact which, when well established, will be of importance in the grouping of the elementary divisions of the New-York system.

## 7. GREY SANDSTONE OF OSWEGO.

### (No. 4. Pennsylvania Survey.)

This rock consists of grey sandstone with a greenish tint, and of dark blue and greenish shale. It is distinguished from the sandstone shale of Pulaski, by the absence of its fossils, and by its connection with the red sandstone, these two masses interlocking with each other: the lower part of the latter mass is non-fossiliferous, and the upper part contains fossils wholly different from those of the Pulaski rock.

This sandstone is the next mass to the sandstone shale of Pulaski, resting upon and bordering it to the west and south in the third district. The sandstone is not in very thick or regular layers, and it contains but little shale. The color generally is grey, with a greenish or olive tint; it is fine-grained, and has no tendency to decomposition in any of its localities. It therefore makes a durable building material. It is often dotted with hydrate of iron.

The fossils so numerous in the mass below the grey sandstone disappear with it, leaving only a few fucoids to be seen, which are on the surface of the layers, and are not well defined. Singular contortions are also visible upon its layers, and in some of them are curved lines as if the result of a concretionary action.

The grey sandstone is of considerable thickness: It forms the whole mass of the falls of Salmon river, which is one hundred and seven feet in height; the rock rising above that point, and extending some feet below the bottom of the falls, as its dip is there against the stream.

The sandstone makes its first appearance in the Mohawk valley, at Woodruff's quarry, to the southwest of Rome. It is there a light grey rock not in regular layers, the upper ones much broken into fragments. Some portions make excellent grindstones. This sandstone is quarried to a considerable extent, and most of the dressed stones used at Rome are from this quarry. No fossils are found here. It contains some pyrites in small knobs, which by alteration discolors the stone, and also the same mineral in minute particles, which are perceptible by the yellow or ochry points produced when altered. This character is often exhibited in the grey sandstone.

The grey sandstone is seen in the road from Rome to Verona, to the west of the quarry, making a small rise on the road. Its color is whiter than usual, probably from exposure, but shows numerous dots of hydrate of iron. In the vicinity are some small patches of the same kind of rock, in which I found two imperfect bivalve shells, neither their species nor even their genus were recognized; also a specimen of the contortions so often seen on the surface of the upper part of the mass, in Oswego and the northern part of Oneida county. Further west, the sandstone is concealed by the alluvion which extends on both sides of Wood creek to Oneida lake; but it reäppears from under the alluvion, and covers the greater part of the towns of Camden and Florence in Oneida county, as well as the whole of the northeast part of Oswego, with the exception of a patch of red sandstone in Redfield. It forms the whole middle portions of the towns of Mexico, New-Haven and Scriba, disappearing under Lake Ontario about two miles west of Oswego river. A reference to the map will show more precisely its geographical distribution in those two counties, and in Lewis, of which it forms the southwest portion.

The most prominent points where the grey sandstone was noticed, are the following:

On Mad river, about a mile and a half above the village of Camden, where it forms the sides and bottom near Mather's mill. Some of the sandstone is of a grey color, like that of Woodruff's quarry; others of an olive grey, with shale, and in thin layers or flags. A section near the mill, shows at the top, sandstone in irregular layers, very various as to texture; under this, the same, but slightly shaly, with accretions, some of which are two or three feet long and eight or more inches in diameter, the lower part with some imperfect fucoids, and the layers in parts contorted: no other fossils were noticed. It presents here the dots of hydrate of iron common to this rock, and the same flattened accretions of fine shale so common also to the red sandstone and to the sandstone shale of Pulaski, more especially as it appears in the quarries to the south of Rome. The layers on Mad river dip with the river.

At Cropper's mill, which I did not visit, there is stone of a good quality for building.

The grey sandstone is quarried about three miles below Mexicoville, in the bed of Salmon creek, and in the flat adjoining it, the rock rising but a few feet above the water. It is a hard stone, in layers from the size of flags to a foot in thickness, separated by a dark olive-colored coating, the surface of the sandstone frequently presenting fantastic forms, and some fucoids. The dip of the rock is very slight. The grey sandstone, judging from the streaks in the red sandstone which forms the ledge in the creek at Mexicoville, must be within a short distance of that place, these streaks only appearing where the two rocks join each other.

On Catfish creek, near to New-Haven, the grey sandstone is exposed; also in the creek to the east of Oswego river, and on the lake shore upon both sides of the river at its mouth. It is quarried on the lake, upon the west side of the village. Its color is greenish grey, showing here and there red spots, and also light streaks of red. Occasionally thin portions of the rock would appear like a conglomerate, being formed of red and green shale with sandstone, the shale in flat or compressed forms rounded at its angles and edges, and the grain extremely fine. They bear no marks of attrition, but are evidently the product of accretion. The red mottled appearance of the green sandstone when first seen, showed that the red sandstone was not far off; the number of spots, etc. increasing near the line of the junction of the two rocks, the red sandstone being found a few hundred yards to the south up the river, at a high level, both above and below the dam. The greater part of the red sandstone used at the village shows greenish spots, the two rocks each presenting spots of the color opposite to their own.

The grey sandstone may be traced in the river on the west side to within a few yards of the spot where the red sandstone appears above it, both ranging nearly horizontally. The surface of many of the red and grey sandstone layers at the point of junction, contains fucoids, and appearances of a singular kind, some of which resemble the forms which a surface would present if slightly viscous, subjected to various movements, and then suddenly become fixed or solid.

The greatest exposition of grey sandstone is on Salmon river, commencing about four to five miles above Pulaski; continuing up above the high falls, where the rock ceases, and then again on its north branch, also called *Mad river*.

At Salmon falls, the lower part of the rock is like that elsewhere observed, consisting of rather irregular alternations of sandstone shale, and frequently showing accretions and contortions of its parts, but upon a small scale. The upper part contains less shale, the sandstone is in thicker layers, and the color is of a lighter grey, that of the lower being a dark blue or green. I saw but one impression of a shell in the upper part of the rock, and a few imperfect ones in the lower part.

The configurations upon the surface are numerous in the layers of the lower part of the falls, particularly on those that are very solid and fine-grained. Many of them are highly curious.

The joints in the sandstone are numerous at the falls, dividing the layers into quadrangular blocks, either rhombic or more or less square. Some of the upper layers are a foot or more thick. The rock dips slightly up the stream, and inclines to the west side. The falls, it is said, have receded two rods in thirty years; not by the decomposition of the rock, but by frost, and the weight and movement of the water which flows over the ledge.

Not far from the falls, is the grindstone quarry; it is on the east side of the river. The upper layer is much contorted; those below it, for about twelve feet or more, are mostly good building stone. Some parts are thin, and of sufficient surface to be used for flags, but are not very straight. There is but one layer suitable for grindstones; this is from eighteen inches to two feet thick, but not uniform in quality throughout its mass. It lies at the bottom of the quarry. It has the dots of hydrate of iron; the cause here and at the falls being very obvious, and the result as before mentioned of the decomposition of pyrites.

The rock is of an excellent quality for grindstones, but too hard for scythe stones. The grindstones, in their finished state, sell for fourteen to twenty-four shillings per one hundred pounds.

The grey sandstone forms three falls on the north branch of Salmon river, the lower about forty feet, the two upper over twenty each, and not less than about one hundred feet of the rock is there exhibited. The upper fall has for its upper rock the same peculiar mass which appears on the top of the grindstone quarry; and the rocks below, forming the falls, presented an accordance so great with those of Salmon falls as to leave no doubt of perfect identity, the one series being but a repetition of the other.

Very little of the northeast portion of Oswego is settled; and such is the case also with the whole of that part of Lewis county which is covered with the grey sandstone, and which forms its southwest border. No road or any means of communication exists between the two counties, where this rock is the surface mass. This shows, notwithstanding the general diffusion of alluvion or drift, that soil is in no small manner influenced by the rock beneath it; that a sandstone like this rock, would yield an inferior soil to shale and limestone; and that until the better soils were fully occupied, the former would remain in a measure uncultivated.

## 8. MEDINA SANDSTONE.

*Red Sandstone of Oswego, Niagara Sandstone of the Reports. Saliferous Rock of Eaton.*

(No. 5. Pennsylvania Survey.)

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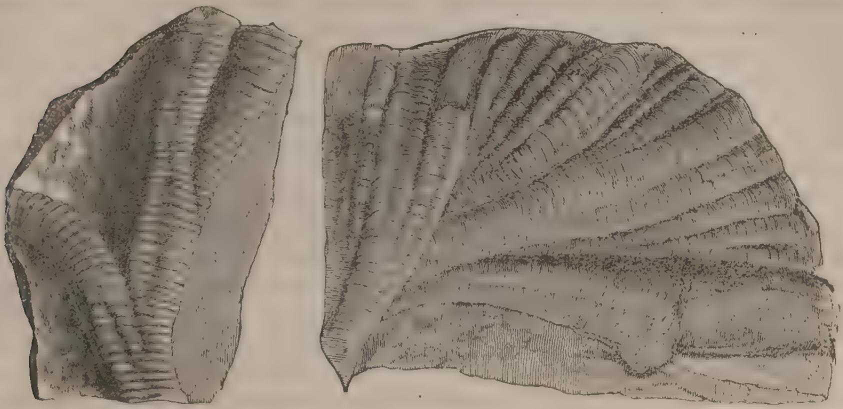


This rock succeeds to the grey sandstone, no defined line of division existing between them. In this rock we find the *Fucoides harlani*, the fossil figured in the above wood-cut, and in none other of the whole of the New-York system has it been seen. It appears, therefore, to be one of those fossils which are limited to a rock, and which affords us a positive character whereby to recognize the rock or its position in the great series. The observations in New-York have been fully confirmed by similar ones in Pennsylvania. There this fossil appears in the same position, and in sandstone of like diversity of character as to color, etc., as in New-York generally. It is abundant on the Juniata, and on the west branch of the Susquehannah. I first found this remarkable fossil in Virginia, about fifteen years ago, near the top of Flat-top mountain, a little to the west of the Salt valley above Abingdon. It was in white sandstone, which caps that mountain, and which rests upon a red sandstone reposing upon a grey or olive calcareous sandstone containing numerous testaceous fossils, referable rather to those of the sandstone shale of Pulaski, than to any other part of the New-York system. These facts are given to show the confidence which may be placed in certain species of fossils, as a character to determine the position of a rock.

This sandstone is almost invariably of a red color, generally a brown red, more rarely variegated light red and yellowish, and in a few rare instances a light or whitish color partially greenish. It is both fine grained and coarse grained, the latter usually of the deepest color; the former more variegated. The innumerable reddish-colored paving stones, and pebbles both large and small, which are found in this district, are formed out of this hard rock. They are plentifully strewed over the surface of the southern counties, and also form a considerable portion of the rolled stones of the Mohawk and other valleys to the west and south of Lewis county.

Some of the layers or parts of the red sandstone show, at their junction with the grey sandstone, that the oxide of iron, its red coloring matter, has been transfused through its material, penetrating as far as its particles could find admittance. This is easy to conceive, as the greater part of this rock consists of coarser materials than the grey sandstone, and its particles are less disposed to form accretions, or to *accrete*, than those of that rock; the coloring material would therefore find a more ready passage. Though the red color is seen below some of the grey layers, it is no argument against transfusion; for the iron might have been admitted at a distant point which was permeable, and then find its way at a lower level to the place observed, and below parts of impermeable layers.

There is another view, which is this, that a mechanical mass may undergo a change subsequent to its deposition, in which the red oxide of iron may, by chemical action, be converted into the black or green state. That a connection exists between the cause of crystallization and color in certain rocks, is evident; but for the present, in the instance of the red sandstone, the apparent cause is preferred. The numerous highly important facts, which observations on Infusorial bodies are now making known, will no doubt modify any opinion or theory founded upon transfusion or chemical action in the color of rocks, and thus offer a third known cause of their color. The property which some of these remarkable bodies possess of changing ordinary dark-colored mud sometimes to a bright green, and at others to a deep red, requires a suspension of opinion upon the subject, until something like a limit to their operation can be discovered. They form a part of the present active powers of the earth; and judging from the discoveries already made, and from rational analogy, their limit downwards as active powers will not readily be discovered, unless admitted to be the connecting link between inorganic and ordinary organic creation, and therefore the precursors of the beings which constitute the visible creation to our common or natural eye.

The red sandstone is found only in Oneida, Oswego and Cayuga counties, with the exception of a small portion of Lewis. It appears merely in a few patches in the town of Florence in the first named county, resting upon the grey. It no doubt will be found in the southwest part of Vienna; extending from Oswego, where it underlies the alluvion, covering more than half the county to the south of Lake Ontario, and extending west from Oneida to Cayuga county. In Oswego county, it also appears in the northeast part of the town of Redfield, extending into the town above, and for a short distance into Lewis county, being the only part of that county where there was reason to believe that it existed.

The first locality met with going west in Oswego was on Little river near Painter lake, and near the town line of Constantia. It extends along the river for about one-eighth of a mile, forming the banks, but much covered with moss. Stone has been taken from this ledge for the furnace at Constantia, and for Mr. Monroe's tannery on the river.

It is again seen at Squire Parks' mill dam, to the east of Amboy centre, with some small accretions of shale which look like rounded fragments; these, by decomposition and removal, produce cavities in the sandstone. Yellow spots of hydrate of iron are also observable upon the sandstone.

At Petrick's mill, half a mile to the east of Colosse, the red sandstone appears in the bottom of the creek under the bridge. It is of the harder variety; and like all the sandstone of this mass in the district, it appears to resist the destructive action of atmospheric agents much better than the same mass in the fourth district, being less mixed with argillaceous materials. Loose masses or fragments of the sandstone are very abundant around the village, being used for field enclosures.

On the same creek, about four miles below, it forms the low fall at Mexicoville, being one of its extreme north points. About three sand layers are there exposed, with some streaks of grey, the layers about fourteen or more inches thick. From the small exposure here and in most other places, the dip of the rock was difficult to determine, appearing to be horizontal.

The greatest exposition of the red sandstone in Oswego county is at Fulton, on both sides of Oswego river, forming the banks and the falls. The upper layers are covered with Fucoides harlanii, some in admirable preservation and of gigantic dimensions, intermixed with the smaller and more common variety. In some of their parts the fucoids have been replaced by small pebbles, showing a peculiar organization and material which could admit of such replacement, the form being well preserved.

The upper layer of the falls is a hard, light-colored, variegated red sandstone; the next below it, is a mixture of sandstone and slate, more or less friable, and of a dark red color; the third, a red and grey sandstone, and of intermediate shades, which is quarried for buildings, hearth stones, etc.; and a fourth, same as the third, with the color more general. Each of these layers is about two feet thick.

The sandstone is seen for half a mile below the falls, by the side of the canal path. A considerable part shows the water lines of deposition, being formed of wedge-shaped masses of unequal dimensions as to length, and either curved or straight. These are again subdivided, the parts being disposed at various angles to each other, and generally arranged between parallel lines, conformably with the other layers with which they are associated, the whole being nearly horizontal. Along the bank this structure extends to two or three layers, but at the falls it is confined to the one below the upper rock.

These oblique lines of structure are seen to greater advantage in the red sandstone of the Clinton group in Herkimer county, and are highly characteristic of the grey sandstone of the Catskill group as it appears in Otsego, Chenango and Broome counties. It is the common structure of the roofing slate of the Hudson group, and is also seen in a hill of sand through which the Camden and Amboy railroad in New Jersey passes.

Three causes present themselves in explanation of this structure; 1, oblique depositions by water or wind; 2, infiltration of water, carrying and depositing the finer particles in an oblique manner; and 3, the crystallization of either one or more of the constituents or parts of a rock in which this structure exists.

On the west side of the river, the oblique structure is not very observable, but the layers are well defined, and like those of the falls; they show a dip up the stream, or to the south, which proves conclusively that the falls were formerly higher than they are at present.

In the upper rock of the falls, there are small globuliform masses, an inch in diameter, of red colored sulphate of barytes, such as are found in the same rock at Rochester.

Fulton is the highest point up the river where the red sandstone was seen, the dam at Oswego village being the lowest point. No other rock whatever is observable upon it between the two places, or in any part of the county represented as being underlaid with this rock. Though but one place was noticed where the Fucoides harlanii was seen in place, namely, the falls at Fulton, yet from the blocks and other small fragments, round and angular, which show this fossil, it certainly was once abundant in the county, and is yet, but is covered with alluvion and soil.

The red sandstone forms the whole of the north part of Cayuga county, extending from a line a little south of the falls at Fulton, over towards the head of Little Sodus bay. It is well exposed in the bottom of the creek at Stirling Centre, and in its sides, extending along the creek to McFarlane's mill, a mile south. At Stirling Centre, the mass exposed is about twenty-five feet thick. The same sandstone appears in the road near Robert Hume's, about two and a half miles from Stirling Centre, and four from Martville; and also in a quarry between Martville and Hannibalville. Here are the two kinds: the hard and variegated, which shows the diagonal structure; and the more coarse and friable, of a darker color. The Fucoides harlanii was not met with in place in the county.

The red sandstone is geologically the lowest rock of New-York which contains brine springs of sufficient purity and quantity to be manufactured into salt. These springs are numerous, and at considerable distances from each other, being found from the eastern part of Oswego, to Niagara river. A salt spring exists on the land of Mr. Kenyon in the town of Hastings, at an old beaver-dam; and at George G. Grizzle's in the town of Palermo, Oswego county. At Stirling Centre, a brine spring rises by the side of the creek, through a fissure in the sandstone; and another spring exists near McFarlane's mill, and a fifth near Little Sodus bay. The salt from all these springs was said to have had a sharper taste than that of common salt, owing probably to a more soluble muriate with an earthy base.

Before it was known that the Clinton and Niagara groups were placed between the red sandstone and the red shale of the Onondaga salt groups, the two masses and their saline sources were considered to be the same, which created no small confusion among those who examined these different masses in accordance with their supposed and not their true relationship to each other.

## 9. ONEIDA CONGLOMERATE.

*Shawangunk Conglomerate. Millstone Grit of Eaton. Grey Band of Rochester; being a sandstone to the west, and a conglomerate and sandstone to the east.*

(No. 5. PENNSYLVANIA SURVEY.)

This is the oldest distinct conglomerate rock or mass of the third district. It is the same with the *Shawangunk Conglomerate;* its position being so well defined in Oneida county, is the reason why the name *Oneida Conglomerate* is retained. It is composed of quartz pebbles, rarely exceeding three-fourths of an inch in diameter, and of white or yellowish quartz sand. In some localities, there is some interposed greenish shale.

The rock is first seen at the east end of Herkimer county, on the south side of the Mohawk, exhibiting merely its northern outcrop, and extends west through Oneida to Stony creek, the creek being the last place where it is seen as a solid ledge, from thence to Cayuga county; but its blocks are very numerous on Oneida lake, and on the bank in the rear of the lake, to the east of Cleaveland, formerly Constantia. From their number, large size, and not being water-worn excepting a few near the level of the lake, and being in the line of the direction of the parent mass in Oneida county, they cannot be far from their original position.

The conglomerate, in small blocks, occurs in the alluvion above the dam in the village of Oswego, and similar blocks are occasionally met with on the surface. For three or four miles to the east of Oswego, they are rather abundant; and near the village of Scriba, on the road to New-Haven, they are quite numerous, and continue along the road for a mile or two, gradually diminishing in number farther east. Beyond Oswego county, the pebbles of the conglomerate disappear, sand taking its place. It reäppears as a ledge in two quarries in the north part of Cayuga county, but without pebbles, having the same character as a sandstone as at Rochester, and accompanied by a similar green shale. Its greatest thickness is in Oneida, being from thirty to forty feet, and diminishing as it recedes from thence. The source of its materials was to the south, being of great thickness at the Shawangunk, and of still greater thickness in the Blue ridge of New-Jersey and Pennsylvania.

The conglomerate rests upon the Frankfort slate and sandstone in Herkimer, the base of the Pulaski shales in the eastern part of Oneida, and the Pulaski shales and grey sandstone in the western part. In Cayuga the conglomerate must rest upon the red sandstone, the two rocks being near to each other, and no intermediate one there existing, but the space between them is covered so as to conceal the contact. Such also would be its position in Oswego, were the whole of the alluvial of the north border of the lake removed, and the conglomerate left in its original position.

The conglomerate forms a part of the Clinton group, the next mass in order of superposition. It was separated, as being a convenient point for division, and from the importance which was once attached to this rock, having been confounded with the conglomerate of the

Coal era, thus giving rise to the wildest calculations, and distorting the whole of the geology of Western New-York.

No fossils have been observed in this rock, except fucoids; these are rare, and have only been found near New-Hartford Centre. They are smooth, cylindrical, ramose, many about three-fourths of an inch in diameter, and are vertically arranged in the rock.

The first place to the east where the conglomerate is seen, is at the new mill below Vanhornsville. The foundation of the mill is in the Frankfort slate, with graptolites, the conglomerate resting immediately upon it. The mass is about ten feet thick; the lower part contains pyrites. But a few feet of it contains pebbles, the greater part being a white or grey sandstone; the pebbles are at the lower part, and the whole mass is intermixed with green shale.

A conglomerate forming a low bluff of about ten or twelve feet, appears in the road from Fort-Plain to Richford springs, a few rods above Lathrop's tavern. It is more colored than in any of its other localities; still it is the Oneida conglomerate, the well at Lathrop's being in the Frankfort slate, unless the masses above the conglomerate at the mill have coalesced, which is possible.

The conglomerate forms the rock of the high falls at Yawheiur creek, a branch of the Otsquago, to the west of Lathrop's. It is there, and at the creek near Wicks' store in the town of Stark, but two or three feet thick, unless it be connected with sandstone masses above, which are two or three in number, and from four to five feet thick, separated by green shale.

The conglomerate appears in Fulmer valley, and in Steele's, Dygert's and Myers' creeks in Herkimer county. These creeks intersect the high ridge at right angles nearly, and expose the conglomerate and other rocks which compose the hill. The conglomerate is more uniform in character in these creeks; pebbles are numerous, and the mass is from fifteen to twenty-five feet thick.

South of Mohawk village, the conglomerate is exposed on the road to Litchfield, forming a terrace upon which the Clinton group rises, and showing a cliff of the *grey band*, the terminal mass of the latter group.

The conglomerate is well exposed in Starch-factory creek, and on the brow of the hill to the west of the creek, where it appears at a considerable elevation, in consequence of its greater projection north. Its thickness is well shown at the falls of the long and deep ravine or gully to the south of the hill, and east and south of Utica: there it appears to present its maximum thickness of about thirty-five feet. There is a little greenish shale in some parts of the mass, which tends to divide the rock into imperfect and very irregular layers.

Loose blocks appear in the hill to the south of Utica; the rock is seen in place in several parts, but not much of it is exposed.

Between Myers' creek and Utica, the conglomerate frequently shows cavities of about an inch in diameter, which appear to be owing to a want of cohesion in the sand which filled the cavities; or these particles were cemented by a colorless soluble mineral, which, when dissolved or removed, and the stone fractured, fell out, leaving the cavities in question. The same kind of cavities were noticed in the lower layers of the Potsdam sandstone in St. Lawrence county, the origin being obviously due to the withdrawal of a substance from the sand by the attraction of the mass in which the cavities exist.

On the road from Utica to New-Hartford, a quarry of some extent was opened in the conglomerate on the land of Mr. Mason. It forms the point of the hill to the southeast of the Mohawk river and Sauquoit creek. Its surface shows in some places the movement of a hard body upon it, being smooth, and its pebbles ground, as if prepared by art to receive their polish. Scratches were noticed upon the smooth surface, but not well defined, and their direction was that of the Sauquoit valley.

The rock at the quarry is a very variable mixture of sand and quartz pebbles, solid and somewhat friable, white, yellowish and even of a pink-color. The mass is nearly horizontal to the eye, and is divided into layers which are not very regular or continuous. On the side next to the Mohawk, the upper layers only are quarried. On the side facing the creek, it is opened lower in the mass, and the divisions are thicker. The Frankfort slate, upon which it rests, may be seen at several points on the hillside to the south of the quarry, beneath the conglomerate.

From the east end of Herkimer county to the town of Westmoreland, the lowest part of the conglomerate shows a mass of pyrites and pebbles, of about ten inches in thickness. Pyrites were not noticed at Mason's quarry, but occur in the same position in the conglomerate on Mr. Smart's farm, to the west of the Sauquoit, on the road from New-Hartford to Clinton. Further west, in a wood below the waters of the farm of James Wells, there is a considerable exposition of the conglomerate, the hardest yet seen, in parts appearing to be crystalline. In places, its parts have been disturbed from water passing under it, and removing portions of its foundation. This mass appears to have been deposited from agitated waters, being full of waved lines as though from opposite currents. These are shown by red and yellowish coloring matter, as well as by its pebbles. This was the ledge from whence stone for the Chenango canal was taken. From the yellow stains upon the stones at the locks and bridges when used, the conglomerate must contain pyrites in minute particles, disseminated throughout portions of its mass.

A short distance from the canal, and a little north of Stebbins' creek, the conglomerate appears in a low hill, and has been quarried. The surface of the rock shows a wearing from water, and some obscure scratches. The layers appear to be unusually inclined — about 10°. The rocks at Stebbins' creek, which succeed to the conglomerate, appear also to exhibit a like angle of inclination at the point where the conglomerate is seen, but it may be apparent only.

The conglomerate is quarried on the farm of David Mansfield, about one mile and a quarter south of Hampton village. Stems of fucoids traverse some of the layers. It is exposed for a considerable extent to the north of Oneida springs, at about one hundred yards from the house, extending east and west, its surface being very little below the level of the county, which is there flat. Some of its layers are four feet thick. The surface has been worn smooth in many of its exposed parts.

The next and last place where this rock was seen in Oneida county, was at the Stone pound near Stony creek, which probably takes its name from the naked surface of this rock which is there exposed: the pound is built of it. It is there in more solid blocks and layers, and more acres of it are exposed, than in any other part of its range. It is divided by joints in two directions. It shows the waved lines of deposition or infiltration, as in New-Hartford, etc.

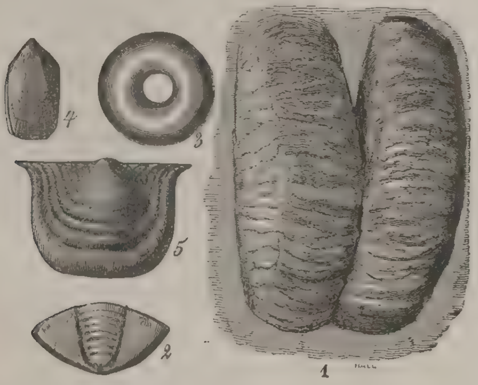
From the Stone pound there is no ledge of this rock to be seen in all Oswego county, which, from the swampy nature of the country to the east of Oneida lake, and the thickness of alluvion along the whole north side of the lake, is not extraordinary; but it appears in the north end of Cayuga county, at Bentley's quarry, about half way between Martville and Hannibalville. It is there a light greenish grey, fine-grained sandstone, in parts mottled with green shale, and in a few parts with reddish purple spots of ferruginous shale. It was quarried for the mill at Martville. The thickness excavated is about four or five feet. On the top is shale, and the thin layers of greenish sandstone which belong to the Clinton group; and at a lower level in the same quarry, is the red sandstone. The same mass is also quarried on the farm of Robert Hume, four miles from Martville, two and a half from Stirling, and one from the Oswego state road. It was opened for Wolcott furnace. The rock is the same as at Bentley's, and in all respects similar to the grey band, as it appears in the fourth district, from specimens collected by its geologist; the term *grey band* having been used to designate two different rocks or masses as to position, one placed at the bottom of the Clinton group, and the other at the top, and the iron ore beds, the green shale, the fucoides, etc. separating the two.

## 10. CLINTON GROUP.

*Lower part of the Protean Group, divided into Clinton and Niagara Groups. Ferriferous Slate and Ferriferous Sandrock of Eaton.*

(Part or the whole of No. 5, Pennsylvania Series.)

11.



No. 1 of the wood-cut. *Bilobed fucoid* (F. biloba).
No. 2. Tail of the *Clinton hemicrypturus* (H. clintonii).
No. 3. *Encrinal disk,* rounded by solution.
No. 4. *Clinton lingula* (L. clintonii).
No. 5. *Depressed strophomena* (S. depressa).

This group, so well characterized by its iron ore beds, and its marine plants, both in this district and in Pennsylvania, extends east and west through the district, resting in its whole course upon the conglomerate; and is therefore found to the south side of the Erie canal through Herkimer and Oneida counties, but to the north of the canal through Madison, Onondaga and Cayuga; extending on both sides of Oneida lake at its west end, passing out of the district near to Lake Ontario on the north side, and on the south side by a line which passes from the south side of Oneida lake to a little north of Wolcott village. In Herkimer, and in the east part of Oneida, it exhibits but little more than its northern outcrop, excepting where streams have exposed its surface and lateral edges; but further west, it becomes a superficial mass, or surface rock, forming a part of the great western level.

At Sharon Springs, in the north part of Schoharie county, this group and the Niagara group are not to be seen, having come to their end; and the Onondaga salt group and the Frankfort slate are so near to each other, both being undisturbed, as to preclude every other deposit.

The Clinton group consists of many different kinds of rocks or masses; from which circumstance, the name of *Protean group* was given to it the first year that it was examined. It then embraced the Niagara or Lockport limestone and shale, which formed the upper part; they were separated on account of their importance in the west, and their disappearance in Herkimer county. The name of *Clinton* was given to the lower part, the characteristic masses being found around the village of Clinton in Oneida county, and as a tribute to one who spared no effort to extend a knowledge of science, and to add to its acquisitions. The group consists of green and black-blue shale, greenish and grey sandstone, red sandstone often laminated, calcareous sandstone, encrinal sandstone, and red fossiliferous iron ore beds.

The most persistent member of the group is shale. When long exposed, it is always of a greenish hue, but the greater part is bluish when recently quarried: the latter color disappears, and yellow or grey green takes its place. The next member is the greenish sandstone; this is in thin layers, and the surface generally covered with fucoids. The color applies better to the parts which have been long exposed, and not to fresh-quarried masses, which have a bluish tint similar to the fresh-quarried shale. The third persistent member is the iron ore beds; these are two in number, and extend with very little interruption throughout the district.

The other masses, though some of them are thick, yet they are found but in a few towns, and will be further noticed when treating of their localities.

The group commences to the east of Saltspringville, judging from some loose masses and fragments by the road-side south of that village, but no other indication of its existence was observed east of Squak or Otsquak creek at Vanhornsville; there an extensive exposition of some parts occurs, but the order of their arrangement is not so obvious as it is further west. At the foot of the dam are many blocks containing iron ore, in which the *Broad agnostis* (A. latus) may be seen. In deepening the race, a bluish green shale was thrown out, which contained a few small bivalves, unnamed and undescribed, and the *Clinton hemicrypturus*, the tail of which is given in the wood cut. This trilobite has not been found out of this group; nor has the genus Agnostis been seen in this district in any other mass but this and the lower part of the water-lime group, until recently, when it was found in the pentamerus limestone, the next rock in succession to the water-lime group.

The low hill to the east of the road, a little below the factory, is composed of thin layers of greenish grey sandstone, separated by shale of the same color, the surface of the sandstone covered with fucoids. Lower down the creek, on the opposite side, there is a similar hill with sandstone, but colored deeply red with oxide of iron, which has also colored the road and soil around it for some distance, and imparts the same shade to whatever comes in contact with it, showing transfusion rather than combination.

The lower termination of the group is at the new mill below. The mill is built upon the top of the Frankfort slate, upon which rests the Oneida conglomerate, showing a thickness of but a few feet. It is covered with shales, followed by grey sandstone with fucoids and pebbles, with thin layers of shale, the whole of which is capped with laminated red sandstone. Further to the west, between the creek and Lathrop's public house, the sandstone, highly colored with iron, is seen in one or two places along the road, and the red laminated sandstone also.

The creek which flows to the east of Mr. Shawl's house, a branch of the Squak, shows near the road the drab shale and calciferous layers or slate of the Onondaga salt group, and before reaching the falls, a number of the products of the Clinton group, both in place and loose in the bottom of the creek.

Near the falls, is the red sandstone having a laminated structure; below which is sandstone and conglomerate, slightly colored red; then two feet of green shale, beneath which is conglomerate resting upon the Frankfort slate. The iron ore was not seen in place, but the fragments found in the creek showed that it existed there.

The brook which passes by Wicks' store in the town of Stark, exposes more of the members of the group, and the order of arrangement is better observed there than in the creeks to the east. The conglomerate is there not over two feet thick; it is followed by shale; then white sandstone with pebbles, etc. which appears immediately under the bridge. Higher up is red laminated sandstone; then layers of green sandstone with shale, upon which is a greyish white sandstone with some shale and fucoids. This sandstone is the grey band of Prof. Eaton, and is the terminal mass of the Clinton group. The grey band first appears at Crill's, about a mile to the east of Wicks' store, but the mass is not so thick as at the brook. It is of importance, being the only rock to the east which contains gypsum in profitable quantity. The discovery of this mineral was owing to an extensive excavation having been made in that part of the group, at Mr. Crill's, from a belief that silver ore there existed. About twenty to thirty tons of gypsum were obtained, and of the same good quality with that of Nova-Scotia. Besides the white sandstone and the gypsum which were thrown out in making the exploration, there was greenish sandstone, dark olive shale resembling some of the dark unaltered gypseous shale, and some blue fibrous sulphate of strontian in plates, and the same probably, but in crystals, lining cavities in the sandstone, the latter also enveloping the gypsum: some of it so soft as to crumble readily into sand. For more detail, see Report for 1838.

The red laminated sandstone appears in a field to the northeast of Crill's, at a lower level, on the farm of Jacob Wright. The diagonal divisions are very straight, and two or more inches thick. When first seen, it has the appearance of a highly inclined rock, the lines of lamination being so much more prominent than those of the layers. Its color is a blood red; and like the same sandstone of other localities, it is coarse grained, and the oxide of iron appears to have coated the grains of sand. The surface of the regular layers is slightly coated with green shale, by which the two sets of divisions in this rock are readily distinguished.

At Tisdale or Crugar's mill in the town of Warren, there is a favorable locality for the observation of the grey band, the same being fifty or more feet thick. The water of the mill passes over it. A portion of the upper layer contains some smooth vertical fucoids placed near to each other, giving to the rock a columnar appearance. The ravine below, known by the names of Fox hollow and Plattkill, is much encumbered with fallen materials and soil, so that the succession is not readily observed. Some yards below the grey band, is red sandstone with a sparkling grain, and another in thin layers with fucoids upon the surface, of the kinds so characteristic of this group, the layers being soiled with iron; lower down, green shale and thin sandstone with the same kind of fucoids; then sandstone, with diagonal divisions projecting in one place from the side of the ravine like a protruded or up-heaved mass; below this, the Oneida conglomerate appears. The iron ore was not seen, being covered up; but ore was taken from this locality by Judge Clealand, in order to ascertain the quality of iron which it would produce: it proved to be good.

South of the village of Mohawk, and along Steele's creek and its branches, are favorable points for examining the group from the conglomerate to the grey band; this latter, through that section, attains its maximum thickness, being over seventy feet. It appears as a cliff in several points, as on the road to Dennison's, below Eaton Burrill's saw-mill, etc. It is used for lining the canal through parts of the towns of German-flatts and Frankfort. The rock is of quartz sand, white where long exposed, but grey, yellowish and brownish when fresh quarried. It is full of cracks, which divide the mass into conveniently sized stones for handling. Near Mr. Betts', on one of the roads south by Steele's creek, it contains fossils, among which we find the casts of the head and tail of the Dolphin-head trimerus (T. delphinocephalus), which first appears with the iron ore beds in this group, and extends through the Niagara group, with which it ceases; also casts of an orthoceras, and of six or seven undescribed bivalve shells. This is the only locality in this sandstone, where these fossils were seen in place.

The red laminated sandstone may be seen in two or more points. The red oxide of iron which colors it, has every appearance of having been transfused; it does not fill up the interstices between the grains of sand, but has attached itself to their surface, penetrating in part, and presenting a crystalline appearance. It was quarried between the east branch of Steele's creek, and the road which leads to the Mohawk river.

In the first branch of Steele's creek to the west, the upper iron ore bed may be seen in place. Numerous fragments of it also exist in the brook, containing encrinal disks, which have undergone partial solution upon their edges as represented in No. 3 of the wood-cut, and are replaced by lamellar carbonate of iron of a yellow color. Fragments of the Clinton hemicrypturus, particularly the tail, and for this reason it is alone figured in the wood-cut, are found in the ore, and the Broad agnostis also. The ore is a mass of accretions, oolitic, and of rounded fragments of organic bodies coated with ore.

Back of Frankfort, on the road which goes to the furnace and to the Minden turnpike, a quarry was opened in the red sandstone, as was said, for the Ontario Bank at Utica. South of Utica are several points where some of the members of the Clinton group may advantageously be seen. The quarries of Blackstone & Davis are opened in the lower part of the group, below the ore beds; those of Gaylord & Norton in the upper part, above the ore; between which, are the ore pits or diggings of Mr. Wadsworth. The stone of these quarries is carried to Utica. At Blackstone & Davis', there is a thickness of six or seven feet of sandstone; none of the layers, exclusive of the upper ones, are over six or seven inches thick, and some but half an inch, and separated or coated with shale. The color of the sandstone is dark grey, with some parts red; the shale is blue when fresh quarried, but becomes a yellowish green by long exposure. The upper layer consists of a mass of very small pebbles, most of them of white or red-colored quartz, with some elongated small black ones. The top of the layer presents a series of short curves, as if water-worn. This same layer appears on the top of the same sandstone mass near Rodgers' machine factory, and in Stebbins' creek near Clinton. At the two former places it is a foot in thickness; but it thins out going west, being but two or three inches thick at the east end of Stebbins' creek, and disappears entirely at the west end of the creek. This is the case also with the sandstone under it, which has no existence in the creek.

The lower surface of the sandstone at the quarries of Blackstone & Davis is covered with fucoids, a number of which are peculiar to the group, particularly the *Bilobed fucoid*, which I have found in the same group near Bloomsburg in Pennyslvania, and Dr. Locke has discovered it in Ohio also. It has not been seen in any other mass or rock. The fucoids are more numerous upon the layers which are thin, than upon those which are thick. They are of great interest, from their number as species and individuals. As yet they have not been investigated. The Bilobed fucoid appears to belong to a genus in which the terminal part shows two lobes, as in this species, or one lobe only; specimens of the same having been found at Blackstone's quarry, and in Ohio also, showing them to be well defined organic bodies.

A few rods from Davis' quarry, by the side of the small brook which flows through it, numerous fragments of the sandstone belonging to the lower part of the quarry appear, which abound in the Broad agnostis. There are other fossils with it, all notice of which will be deferred for the Report on the fossils of the State. The whole of these fossils are replaced with hydrate of iron, as though their original material had been pyrites or carbonate of iron, the sandstone showing in some parts the same color. The sandstone of the quarries is covered with shale of a yellowish green color, and from eight to ten feet thick, in very thin, leaf-like divisions; which is non-fossiliferous, or else its fossils are so rare as to have eluded observation.

At a higher level are the quarries of Gaylord & Norton; they are opposite to each other, and near the top of the hill, to the east by south of the lower quarries. The sandstone is there of about the same thickness; its color not so dark, and the fucoids not so numerous, but the Bilobed fucoid is of a much larger size, which is also the case with those in the same position on Swift creek, which empties into Sauquoit creek. The Bilobed fucoid is readily known by its division into two parts, and its wrinkled surface. Its outline varies from egg-shaped to straight-sided, and its size from an inch and a half to six inches in length, and from three-fourths to three inches in breadth.

Between the upper and lower quarries are the iron ore pits. This is the kind noticed by Dr. Beck, under the name of *lenticular clay iron ore*. It is the *fossiliferous iron ore* of the Pennsylvania survey. In all its localities it is red or brownish red, very hard when unaltered, invariably oolitic, or in larger sized concretions. There are two beds generally, about twenty feet apart, upon an average about a foot and more in thickness. The oolitic particles are usually more abundant in the lower bed, the larger sized and other forms of concretion more abundant in the upper bed. In the lower bed there is sometimes brownish shale associated with the ore; also, in two localities, some bluish black grains of oxide of manganese. Fossils in fragments or parts are very numerous in the upper bed, but they are not so much so in the lower one.

In the fourth district, these two beds appear to be separated by the calcareous shale which contains the Pentamerus oblongus, one of the very characteristic fossils of this group, though it is not continuous with the group in all places. Though in such vast quantities in that district, being found also in Indiana and in the Caradoc sandstone of England, holding the same relative position, it is rare in the third district, having been seen in place only at Donnelly's ore bed in the town of Lenox, and to the west and south of Verona, and in fragments merely, believed to belong to the upper, which is there a broken up bed, the whole of the surface being uncovered to near the lower ore bed.

The ore is very near the surface at Wadsworth's pits, and is of easy extraction. None is used, nor will much of this extensive deposit be used, so long as individual interests predominate over national or social ones; it being more advantageous to use Scotch pigs, either with a portion of the ore, or by themselves, than to obtain iron from the ore, though it exists so abundantly and conveniently.

The ore at Wadsworth's belongs to the lower bed. It is highly oolitic; it has brown shale, and contains the Broad agnostis. In the shale which covers the ore, a few arborescent appearances occasionally are seen; they are flat, smooth, and of lighter color than the mass. The same have often been observed upon the surface of other rocks, such as the Trenton limestone. It is difficult to determine whether the cause is due to organization, or to a ramose transudation of moisture collecting and arranging the fine particles of which they are composed. They are probably referable to the latter cause, though no difficulty exists in attributing to them an organic origin.

One of the best localities for observing this group is on Swift creek, which flows by the side of Rodgers' machine manufactory, into Sauquoit creek; more of its members are there seen, and the order of superposition is better exposed. A series of shales, and thin layers of sandstone with fucoids, occurs between the factory and the entrance of the ravine; the Oneida conglomerate not being visible, the same mass of sandstone which is quarried at Blackstone and Davis' appears, and is also quarried, and presents the same peculiar characteristic fucoids and other bodies in relief, etc. The shale above the quarry contains fossils, among which is the Broad agnostis.

The shale above the sandstone which is quarried, is from thirty-five to forty feet thick, making the third mass of the group in the ascending order. The top of the shale is covered by a layer of hard greenish grey sandstone, fourteen inches in thickness, upon which rests the lower bed of iron ore. The ore is about a foot thick, highly oolitic, and the purest of the two masses: no fossils were observed in it. Above the ore there is about twenty feet of greenish blue shale, with thin layers of the same colored sandstone with fucoids, upon which is the second ore bed. This is not so pure as the lower one, from a mixture of limestone chiefly. It is oolitic and encrinal. The mass, for a few feet below and above the ore, is a mixture of limestone, shale, etc. containing numerous fossils, among which is the Clinton strophomena (S. clintonii), a shell which is flat, semi-elliptical, with numerous rays, well defined and nearly equal -- size about an inch in the length of the hinge: also others to be hereafter noticed, among which is the well known European fossil, the Strophomena depressa. Here it first appears going west, and is found in no lower position in the district than the Clinton group. The bed of ore is about two feet thick, but it is much intermixed with the calcareous and siliceous materials of the shale and slate.

Above the ore is a mass of greenish blue shale and slate, with similar and darker colored sandstone, of a thickness of thirty feet or more. Near the top of this mass is the same body of stone quarried at Gaylord and Norton's to the south of Utica, but it is not so thick. The Bilobed fucoid is of greater size here than in any other of its localities. The remaining parts of the group are not well exposed; the sides of the creek are low, the ground becomes more level, and loose materials abundant; shale and sandstone appear, and finally the masses which belong to the next group above; and then the shales of the Onondaga salt group, which form the next rise by the side of the creek.

At Reed's saw-mill near New-Hartford, the two ore beds appear, and are about twenty feet apart. The lower bed is of better quality than the upper, which is about two feet thick, the lower one foot. The fossil shells connected with the upper ore bed are more numerous and better preserved at this locality, than in any other yet noticed in the district. Not far from hence is the last locality of the red sandstone of the group.

On the road from New-Hartford to Clinton, there are several excavations for iron ore by the road side. The ore lies very near the surface, being covered by alluvion only. From long exposure, it has lost portions of its cement, and is friable and more pure. Its greatest thickness is about two and a half feet. It probably belongs to the lower bed, according to observations made further east as to quality of ore; but judging from its thickness, it should appertain to the upper bed. Though holding a higher geographical level, it would appear to be geologically lower than the upper ore at the creek to the west. It was examined at an early period of the survey, before the characters of the two beds had been well ascertained.

Beyond these excavations is Stebbins' creek, where the upper ore bed is exposed on both its sides below the bridge. and on a level with the road. Some of the ore is very good, but the greater part is much intermixed with the rock. It is made up of the larger, as well as of oolitic concretions; the former kind, when examined, proved to be corals, encrinites, etc. coated with iron, and often replaced by it, which is the case with all the corals found with the ore, the encrinites being generally replaced by carbonate of iron. There is an increase of carbonate of lime in this part of the group, which continues through the town of Clinton. This mass of ore with its immediate associates is about four feet thick; below which is about seventeen feet of sandstone, shale, etc. and then similar ore, but much inferior; again layers of sandstone and shale about five feet thick, and a layer of iron about ten inches, hard and siliceous; under which is greenish shale of various kinds, with thin layers of sandstone extending to near the bottom part of the brook, the base of the group being covered with alluvion. In the finer parts of the shale below the ore, there are some accretions of sandstone which have considerably deranged the straight courses of the shale. Above the bridge, the layers of shale and sandstone which rise upon the upper ore bed, show for several rods a curve, the centre of which is inclined at an angle of about forty degrees, due probably to lamination.

The next exposition of the group, where it is seen to advantage, is the quarry of Dr. Ruddock, to the southeast of Clinton village. It is of considerable interest, from containing several fucoids and other fossils. It consists of a series of rather thin layers of sandstone, alternating more or less with shale. At the bottom of the mass, is the same kind of ore as the upper mass at Stebbins' creek, only the limestone with which it is intermixed is of a yellow color. In consequence of the valley of Oriskany being somewhat level for a few miles, the group is exposed for some distance to the south of the quarry.

Griffin's quarry towards the north of Hamilton College hill, is another point for the examination of this group. About twenty or more feet are exposed. The upper mass is here an encrinal limestone, stained with the red ore, and containing ore, and is about five feet thick. Under this is the same kind of limestone intermixed with shale, the two appearing as if kneaded together. Under this latter is the same, but with the limestone greatly in excess; some of the layers are a foot and a half in thickness, and contain more iron than the upper part. The ore has the bright copper-colored appearance of the upper mass in Swift creek, being also oolitic, and the encrinal disks are coated with oxide of iron. Other fossils are abundant in the whole mass exposed, all which belongs to the upper ore bed; the ore, both here and at Stebbins', having been deposited through a greater thickness of associated materials. The top of the rock was covered with alluvion, the encrinal limestone having been laid bare previously. This covering prevented an examination for scratches; but these ancient marks were observed by Dr. Penny, the former President of the College, in a quarry near to the Institution. The encrinal limestone was worn smooth, and scratched in a direction judged to be about north and south, being that of Oriskany valley.

Between Griffin's quarry and the College, towards the east, is the quarry of Dr. Hopkins. It shows hard encrinal rocks of limestone and sandstone with iron ore, in several alternations: it belongs to the upper mass. At Dr. Norton's, near by, is the lower ore bed; it is oolitic, and was formerly quarried for smelting.

On the turnpike road from Utica to Vernon, near the town line of Kirkland, is Bennet's ore bed. The ore is near the surface, on the top of the hill. It is the lower bed, being a mass of oolite. It is associated with green shale, and contains some brown shale and oolitic particles of manganese. The shale contains fossils, among which is the Strophomena depressa, the lowest position in which it was seen in any part of the district; also others to be noticed. This is a good point to examine the shale and sandstone below the ore bed, which is here of great thickness.

Between Manchester and Lairdsville, the same ore bed as at Bennet's appears by the road side, having been uncovered by a stream of water. It contains the Broad agnostis. The range of this species in the district appears to be from the sandstone of Davis' quarry, to the upper ore bed; not having been seen either above or below those limits in this group.

Opposite to Lairdsville on the north side, is a deep depression, and a favorable place to examine the position of the two ore beds. The upper part shows about ten feet of irregular shaly sandstone, the layers being thickest in the lower part; under which, about two feet of ore similar to the upper mass at Stebbins' creek, etc., and much intermixed with the rock; below, four feet of sandstone and shale, with fossils quite numerous; then about twenty feet of shale alternating quite regularly with thin beds of sandstone, and limestone showing iron ore; under which is the lower bed of ore about two feet thick, oolitic, with fossils, the same as Bennet's, Norton's, &c.

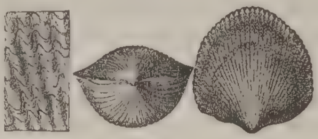
Near the saw-mill, a little higher up the creek which flows through this deep and broad ravine, the upper bed contains some geodes embracing crystallized limestone, quartz crystals, anhydrite, and also what appears to be a mixture of sulphates of barytes and strontian.

Near to Westmoreland furnace, the ore is exposed in many places, particularly the lower bed; and where long exposed, it is of a good quality, the pyrites which it contains being decomposed, and the ore not so hard.

Through the west part of Kirkland, Westmoreland and Verona, the country being more level than further east, a greater extent of surface of the Clinton group is exposed; thereby facilitating the observation of a large portion of surface of some of its members, but not the manner in which they are arranged, an examination of the ends or edges being necessary for that purpose. Near Verona the ore lies near the surface, spread over a considerable extent of ground. It is quarried a short distance to the west of the village, for the Taberg Company, on the land of Mr. Eames; and to the south of that quarry, at Mr. Person's, for the Lenox and Constantia furnaces, and at an intermediate point: the ore is very solid, and from twelve to fourteen inches in thickness. In excavating a well at Verona, it is said the same ore bed was encountered. The deposit at Eames' is covered with eight to ten feet of alluvion, consisting of large fragments of sandstone, ore and slate, the products of the group, partially rounded, and mixed with earth confusedly deposited. The upper part of the deposit consists of a hard sandstone from three to five inches in thickness, with some carbonate of lime, the surface water-worn; under this is a bed of hard shale of a bluish green color, with thin layers of calcareous sandstone; then hard sandstone and shale, below which is the ore, its overlying masses being but a few feet in thickness, and containing an abundance of the *Clinton retepora* (R. clintonii), the same fossil which exists in the mass in contact with the ore at Wolcott furnace, and in the bluish green calcareous shale at Martville, which correspond with the second or upper bed of that section of the State. There is very little apparent dip in the ore bed and its associates at Verona; and were it not for the great thickness of the rocks to the south which succeed to them, and the little elevation comparatively, they might be considered horizontal.

South of Verona towards Oneida Castle, and in other parts, some of the members of the group are exposed, consisting of shale and sandstone, and loose ore belonging to the upper bed. The sandstone is quarried at Tipple's, and on the farm adjoining. It lies in low meadow ground near the surface, and is somewhat altered. The vertical joints are well defined in this stone, appearing in parallelograms, the angles usually acute and obtuse. These forms are very common in the sandstone of the group, being met with in almost all its localities. There are but about four courses of stone which are extracted at Tipple's; the upper one showing iron ore, containing encrinites, etc. There are many large blocks of the ore scattered about, in which geodes similar to those near Lairdsville are found, in which occasionally a peach bloom may be seen, resembling the arseniate of cobalt. In this ore, as well as in the same kind uncovered in the grading of the railroad below Verona, fragments of the *Oblong pentamerus* (P. oblongus) are found, and also the *Allied atrypa* (A. affinis).

12.



This is the lowest point at which any of the species of this peculiar division of atrypas appear; and as there are about six species of them in the New-York System, and as five different names are used for this division in Europe, and without that precision required for identity, the plan adopted is to give a wood-cut where the species appear, and a European name if it can be satisfactorily applied. The above wood-cut represents two views of Atrypa affinis, with a magnified representation of a portion of its imbricated surface by which it is principally distinguished.

From Verona to Madison county, in the direction of the range of the group, but little of it is exposed, the ground being low and marshy. The last quarry noticed was Smith's, about two miles to the west by south of Verona village. It consists of alternations of shale and sandstone, the latter encrinal, and stained red with oxide of iron. The usual fucoids occur with the sandstone.

The Clinton group passes out from Oneida county in the direction of Oneida lake; the whole or greater part of the lake is believed to have been excavated in the group, the covering of alluvion on its north shore preventing actual examination. It is very narrow along the south shore near Joscelin's corners, the limestone of the succeeding group being quarried within a short distance of it.

The first locality of the group in Madison county is at Thomas Donnelly's, on the road from Canastota to the head of Oneida lake. It comes within ploughing depth of the surface, showing the lower ore bed of Wayne county, many masses of which have been thrown up and piled, and others are loose upon the surface. The soil in several places is colored blood red with the ore. For about eighty to one hundred acres of extent the ore has been found, forming a rise of a few feet, the land being swampy on all sides. The ore is mixed with carbonate of lime, requiring, as is the case generally with this ore, to be mixed with argillaceous ores, on account of its limestone; no additional flux of the latter mineral being needed, but on the contrary those which contain silex and alumina; for these three earths, in certain well known proportions, make the most fusible glass or mixture, and which is necessary to enable the particles of iron to come together, without which they would be diffused through the mass; such being the use of a flux, having no action whatever upon the metal, but upon the stony materials of the ore, which must be melted, to allow the particles of iron to unite.

Fossil shells are more numerous in the ore at Donnelly's, than in any of its other localities. It contains the Oblong pentamerus, the Allied atrypa, Depressed strophomena, Radiated delthyris (D. radiatis), etc.

For a short distance north in the swampy ground, the ore may occasionally be perceived adhering to the roots of the trees which have blown over. No rock is seen in place from Donnelly's to the lake shore near Oneida-lake post-office, though rocks are said to exist low in the water at Lewis' point. Back of the post-office, the shore is lined with sandstone and shale, the same kind as at Tipple's quarry. Fossils are somewhat numerous, among which are Depressed strophomena, Clinton strophomena, Allied atrypa, a species of Stenoscisma, Lingula, &c.

At Joscelin's corners, the ore appears between the road and the lake. It forms a mass of about two feet thick, appearing to be divided into two layers of a foot each. It is exposed along a line nearly horizontal, of several hundred feet in length. This ore was taken to Constantia furnace, and no very favorable opinion given of it.

Along the whole line of these ore beds, the country is well settled, and their position is therefore unfavorable for profitable iron works; for the price of fuel must be much above the minimum value, and therefore the richer ores only can be smelted to advantage.

Further west, on the lake shore, a thick layer of the calcareous sandstone appears in the bank at Reuben Bushnell's. It is over a foot in thickness, and rises about four feet above the lake. The upper part contains encrinites, and for two inches in thickness, it is encrinal, laminar, and colored red by iron ore. Here was found the tail of the Dolphinhead trimerus, with a few other testaceous fossils. Under this layer there are others, but thin, consisting of shale and calcareous sandstone. The mass divides into regular forms, owing to joints in two directions, one of which is E.N.E.: elsewhere similar joints were N. 84° E. and N. 45° W.

From Bushnell's, alluvion covers the group to Fort Brewerton; there the shale appears along the bank of the outlet, and in the hill at the village. It no doubt forms the rifts in Seneca river, between the outlet and the town of Granby.

At Bently's quarry, on the road to Hannibalville, it appears on the top of the sandstone, which corresponds with the Oneida conglomerate, showing a series of thin greyish green sandstone and shale, the former containing numerous fucoids and other forms, with the Clinton lingula of the wood-cut, besides some other fossils, the mass exposed being about ten feet thick.

The group appears again on Little Sodus creek, extending from the village of Martville to the mill about half a mile below. At the village are some alternations of shale and calcareous shale, the latter somewhat solid. The whole is fossiliferous, the Clinton retepora (R. clintonii) being abundant; and I found also a specimen of the *Niagara delthyris* (D. niagarensis). The mass corresponds with the series which encloses the bed of ore near Verona, and also that of Wolcott furnace.

At the mill in the bed of the creek, rising for about eight feet in the bank, is a yellow green shale. It contains some fossils, among which is the Broad agnostis, and an Avicula yet unnamed; above which are thin layers of limestone composed entirely of *Shining orthis* (Orthis nitens), the same which occurs above the pentamerus limestone in the fourth district. The mass is covered with about fifteen feet of alluvion, at the bottom of which were fragments of light-colored hard limestone with ore adhering to it, showing that a deposit exists in the vicinity.

The last point in the district where the group was observed, was towards the west of the town of Stirling, on the land of Peter P. Van Patten. There one of the ore beds exists near the surface, numerous fragments being often ploughed up.

The same fossiliferous iron ore, so characteristic of this group, is found, according to Dr. Locke, in Clinton county, Ohio, near the bottom of the cliff limestone, which is its proper position. The peculiar fucoids of the Clinton group (the bilobe and unilobe) are also found near Cincinnati in the same position, showing the extent of its range and the value of the fossil character.

## 11. NIAGARA GROUP.

*Lockport Group. Upper part of the Protean Group, of the Reports. Geodiferous Limerock and Calciferous Slate of Eaton.*

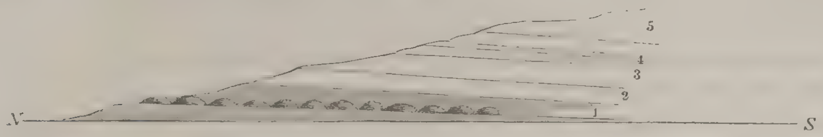
This group consists of limestone of a dark blue or black color, and of dark shale or slate. When the limestone is but small in quantity, it is in hemispheric concretions, whose parts are more or less concentric to each other, like the coats of an onion. The group is very thick in the fourth district, and forms the rocks of Niagara falls; but it thins out to the east, leaving not a trace to be seen east of a line passing south through the village of Mohawk in Herkimer county. It first appears in Steele's creek, to the southwest of that village; then in Swift creek, near the road from Sauquoit creek to Paris hill; at Hart's mill, on the east branch of the Oriskany; in the ravine back of Dr. Noyes' house, near Hamilton college; in Skanandea creek at Vernon village; on the same creek also back of Turkey-street; south of Oneida lake; in the north parts of the towns of Lenox and Sullivan in Madison county; and in the towns of Cicero, Clay, Lysander, Ira and Victory in Onondaga and Cayuga counties.

From the east end of Madison county, it appears generally as a concretionary mass, in one or two layers, enclosed in dark blue slate or shale, not hard, the concretions varying in size from an inch to two or three feet in diameter. It is there too impure to be used as a limestone, and it is but small in quantity; but in Madison, and particularly in Onondaga and

Cayuga, as the limestone increases in thickness, and is of a better quality going west, it is quarried both for building and burning for lime.

The position of the Niagara group is well defined, being south of the Clinton group, upon which it rests, and north of the Onondaga salt group, the latter resting upon the Niagara group, as in the wood-cut below, which shows the shales, etc.: No, 2, 3, 4 and 5 of the Onondaga salt group, and No. 1 of the Niagara group, as seen at Hart's mill on the east branch of Oriskany creek.

13.



In Swift creek in Oneida, large dark-colored flat concretions of impure limestone appear, with some cavities containing crystals of carbonate of lime. These concretions are enclosed in a slate or shale of the same dark color. Between this mass and the red shale there are about twenty feet of blue and greenish shale and slate, all which disappear before reaching Crugar's mill to the east, where the red shale and the grey band must be in contact.

At Hart's mill, on that branch of the Oriskany which comes from Waterville, is a favorable place for examining the concretions of the group; they are there enveloped in the same slate, and present the appearance exhibited in No. 1 of the preceding wood-cut: they are well defined, large, and more connected together than in some of the other localities. In the concretions near Hamilton college, Dr. Noyes found a little galena, blende and crystallized carbonate of lime.

At Vernon, going west, is the first place where fossil shells were seen in the mass; they are quite numerous in the slate which contains the concretions, and consist of the Orthis bicostata of Conrad, the specimens of which were obtained too late for a wood-cut. The concretions are well defined, rising from the bottom of the creek by the side of the village, like mounds in miniature, not being over two or three feet in diameter.

The same concretions appear on the road towards Skanandea, and also in the creek at that village, extending for some distance both ways, the rock forming the bottom of the creek. By the side of the creek at Squire Breese's there is a chalybeated salt sulphur spring, which rises through the rock. It was conjectured to be a highly eligible point to bore for coal, which was the intention of its enterprising owner; but since the survey has proved that the rocks of the New-York System hold an inferior position to those of the coal, the project has been abandoned, and a boring for stronger water will be made. Higher up Skanandea creek, back of Turkey-street, is a favorable point for the examination of the group as it appears to the east, the banks of the creek being higher, and more of the group exposed. It is more variable, the slaty shale predominating near the bridge, and the calcareous layers lower down.

These latter are somewhat numerous, thin, concretionary, and alternating in the bank with slate for ten to fourteen feet. Back of the bank, and rising about five feet above it, are thicker layers, which are quarried. When the layers are thick, the limestone is more pure; some of it is oolitic, and contains cytherinæ, and the surface of the upper layer is thickly covered with Orthis bicostata. Some of the limestone is of a yellowish color, with cavities, and greatly resembles some of the varieties found at Niagara falls.

From Skanandea to Verona, the concretionary mass appears in the road in all its varieties as to form and size, exhibiting concretions whose parts are more or less concentric; others in parallel and diverging parts, regular and confused; and others in large circles like rings, from the removal of the central portions, owing to the upper parts having been worn away. It is very ochery, more so than elsewhere; the yellow stains due to the alteration of pyrites, which often discolors the rock in its other localities.

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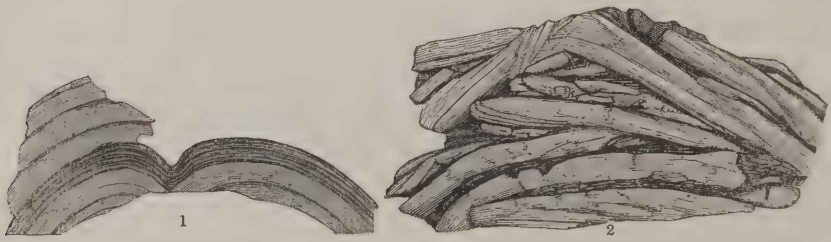
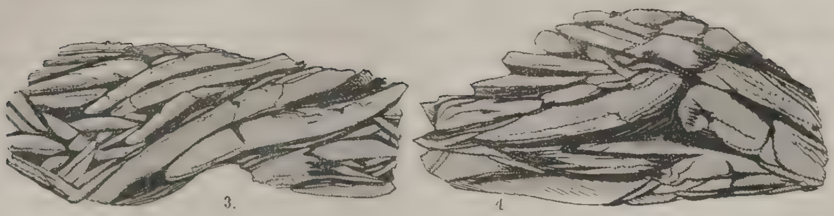


This locality is of interest also from the light which the concretions, either when whole or more or less broken up, throw upon the cause of those appearances which disturbed or deranged rocks so frequently present, the greatest difference being in the scale merely of the two. It is evident that when expansion takes place in a mass, the greatest resistance being lateral as in this rock, it will rise or be forced upwards in parts, with a convex or dome-shaped form, a section of which will be like one of the curves of wood-cut No. 1. Curves of the most graceful kind are exhibited in Pennsylvania and Virginia, and upon a magnificent scale in the sandstone portion of the Hudson river group, evidently due to an enormous lateral pressure which caused the central part to rise upwards as in the concretionary rock. The same kind of curvature was seen in a limestone mass upon a very large scale in the Alps, on a back road from Bex to Sion.

In other instances of the concretionary rock, the action was more violent or the resistance less; parts were broken up into fragments, and thrown up in the form of an imperfect arch as in No. 2. And again others are more disturbed, as in 3 and 4 of the succeeding wood-cut, and are not unlike the appearances of ice when a frozen river or stream is broken up by a freshet, the ice being packed up in all conceivable modes of arrangement.



15.

In these instances, as illustrated, it is very obvious that the concretionary part was the first portion of the mass which had assumed solidity ; and that, in expanding, it was not restrained by the material in which it is enclosed, these two causes being the prime ones of the varied appearances which it exhibits. The action also was entirely confined to the parts immediately enveloping the concretions, the parts above and below them being wholly undisturbed.

In Madison county, this concretionary character is less observable ; but the limestone is granular, shining, and looks like a glistening sandstone : its color is quite dark. It is quarried on the farms of Messrs. Wood and Adams, in the town of Lenox. In Sullivan, it is found on the farm of Joseph Clark, and by the roadside near his house. On the adjoining farm, it is burnt by Enos Hubbard for lime.

Numerous quarries are opened in the limestone rock through the towns of Cicero, Clay, Lysander, Ira and Victory, showing considerable improvement in the quality and in the thickness of the calcareous portion of the rock. The mass is of great importance in all that section of the country, not only furnishing building stone, but also lime suitable for all the purposes to which that article is usually applied, excepting where a very white lime is required.

One of the best quarries to show the position of the concretionary part of the mass, is at Noadiah Hart's, about one mile and a third to the northwest of Betts' corners. The upper layer is in concretions curving upwards, as in the above wood-cut, the texture highly granular. Below this the layers are straight, and make, as was said, a white lime, but they are too thin for building stone.

At Denis', in the town of Clay, on the road to Oneida outlet, the concretions are small, numerous, and resemble those of Lockport, but are not so regular.

The quarries of Judge Bigelow and Ham in the town of Lysander, are on opposite sides of the road from Baldwinsville to Phillipsburg. About five feet of rock, in layers from one to six inches thick, are worked : it is very black. Some of the layers contain some of the smooth ramose fucoids, a few of the Bicostated orthis, and cytherinæ. It contains also some oolite. It is quarried for lime and building stone.

The quarry of Mr. Doud, in Victory, is of greater interest, as affording more fossils, such as the orthis above mentioned, a columnaria also, and an avicula, as well as a slender encrinite not yet specifically named.

At Whiting quarry in the town of Cicero, there are some geodes lined with rhombic crystals of carbonate of lime: Gypsum, in small globuliform accretions, has also been found in some of the other quarries, showing that the same causes have operated in this group as well in the third as in the fourth district; the geodes especially being so numerous in the latter one.

The calciferous slate of Prof. Eaton, which underlies the limestone of Niagara, Lockport, Rochester, &c., which is quite a thick mass at Wolcott village, is seen but for a short distance in the third district. At Hyde's quarry near Plainville, it appears there is a dark colored shaly limestone containing Strophomena depressa, Orthis hybrida which somewhat resembles the O. testudinaria, fragments of the Asaphus caudatus, the Orthis bicostata, and some slender stems of an encrinite which is also found in the group further east.

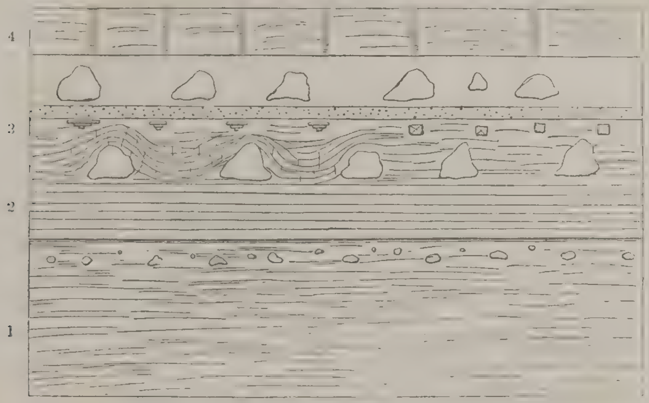
## 12. ONONDAGA SALT GROUP.

*Calciferous Slate, or Second Greywacke, with Shell Limerock of Eaton.*

This is one of the most important groups of the district, containing all the gypsum masses of western New-York, and furnishing all the salt water of the salines of the counties of Onondaga and Cayuga. The group is coëxtensive with the district, commencing in the first district, and extending through the third and fourth districts into Canada. It rests upon the Niagara group, from the middle part of Herkimer county, throughout its whole course west. From the point where the Niagara group terminates at the east, it rests upon the Clinton group; and as the latter group also comes to its end near the first district, it reposes there upon the Frankfort slate, upon which it continues to near the Hudson river.

It forms a part of the high range on the south side of the Mohawk; appearing at the north end of Otsego county, and in Herkimer and Oneida, being its northern outcrop. It makes its first appearance by the side of the Erie canal at the east end of Madison county, and from thence west the canal was excavated in the group; the extent of surface on the north side, after a few miles, becomes as great as that on the south side; the group increasing in breadth on both sides of the canal, in extending itself through the district. The great descent from the high range is due to the dip of the rocks to the southwest, and the rise of the bottom of the valley. The extent of surface which the group covers, or which is exposed to the west of Oneida, was owing to its forming a part of the great level, whose rocks escaped that destruction which befel the same rocks to the east; and those masses which covered the rocks of the great level, shared the fate of the rocks of the level, at the east. That such was the fact, appears evident from the range of the Helderberg division, which extends along an east and west line; the Onondaga salt group projecting beyond that line to the north for some miles, through the three terminal counties of the district. The high east and west ranges of alluvial hills through the towns of Warren, Columbia and Litchfield in Herkimer county, show the action of water upon the limestone terrace which covers the Onondaga salt group, anterior to the excavation of the Mohawk valley, and also the greatness of that action at that comparatively remote period.

16.



The above wood cut represents the order of the different deposits of the group :—

No. 1. Red shale, with green spots.

2. Alternate beds of red and green shale, etc.

3, shows two ranges of plaster masses called *beds*, the lower in part arched; also the hopper-shaped cavities, and the cavities composed of six hoppers arranged with their apex inwards so as to form the cube. Above the cavities is the bed of vermicular, or porous rock.

4. Upper mass, with cavities formed by sulphate of magnesia.

In the Report of 1839, the Onondaga salt group was divided into *four* deposits, as in the annexed wood-cut, which divisions are still retained ; no improvement suggesting itself since that report was presented. There are no well defined lines of division between the deposits ; but for practical purposes, the divisions are sufficiently obvious.

The *first* or lowest deposit is the red shale, showing green spots at the upper part of the mass : it is No. 1 of the wood-cut. 2d, The lower gypseous shales, the lower part alternating with the red shale, which ceases with this mass : they form No. 2 of the wood-cut. 3d, The gypseous deposit, which embraces the great masses quarried for plaster, consisting of two ranges, between which are the hopper-shaped cavities, the *vermicular limerock* of Eaton, and other porous rocks : these products, represented in their order, form No. 3 of the wood-cut. 4th and lastly, Those rocks which show groups of needle-form cavities placed side by side, caused by the crystallization of sulphate of magnesia, and which may from that circumstance be called the magnesian deposit, being No. 4 of the wood-cut.

The whole of these deposits are found between Oneida creek and Cayuga lake. To the east of the creek, they do not all occur, as will subsequently be made known. They thin out to the eastward, and probably terminate entirely a few miles east of the Hudson river ; from which point their thickness gradually increases towards the west, and reaches its maximum in the counties of Onondaga and Cayuga, where it is not less than seven hundred feet. The gypsum has not been seen east of the western part of Oneida county. The red shale comes to its end at the east end of Herkimer county ; and the whole group is reduced, in the Helderberg in Albany county, to a few feet of light grey or lavender-colored compact calcareous rock with pyrites, separating the Frankfort portion of the Hudson river group from the water-lime series.

*Red Shale.* The great mass is of a blood-red color, fine grained, earthy in fracture, with no regular lines of division, but breaking or crumbling into irregular fragments. It is first met with going west at Tisdale or Crugar's saw-mill, at the north end of Henderson's patent, Herkimer county. It would appear there to rest immediately upon the grey band of Eaton, there being no space for the admission of any rock or mass between them. Its grain there is coarse for this mass.

The red shale is exposed to more advantage near the distillery of Elias Fisk, on the west branch of Steele's creek ; there it forms a mass of eighty or more feet in thickness. The manner in which it disintegrates is well seen, crumbling by weathering into angular gravelly fragments, which are finally resolved into red earth. The cliffs are nearly vertical ; and there is nothing to break the uniformity of the blood-red color of the rock, but two parallel beds of bright green shale, each about five inches in thickness. There is a third bed which is not so thick, nor is it continuous, extending only a short distance along the mass, showing that there are beds in the red shale of a different color and of limited extent.

On the road from Mohawk village to Dennison's, to the east of Fisk's distillery, the red shale is seen after rising upon the sandstone of the Clinton group. It there forms a terrace, showing a very uneven surface in parts, owing to the action of water which has destroyed its continuous surface, and has heaped the alluvial materials which were deposited into hills and ridges ; showing upon a small surface, the same action of water, and the same accumulation of drift or water-worn materials, so common to the surface of the Onondaga salt group, and the rocks to the north of it at the west end of the district. The same results have taken place at the west end of Herkimer, and the east end of Oneida, where the Minden turnpike traverses the red shale. In that part of the district, the outcrop of the red shale may be seen at the edge of the terrace at the saw-mill on Myers' creek.

It is faintly seen on Sauquoit creek, but well exposed in the road to Paris hill from the creek, and in several of its northern tributaries.

It is well exhibited on the north and west side of Paris hill, extending south, but concealed by tufa, etc. until it reaches Hart's or Griffin's mill on the road to Waterville ; there an interesting section exists, showing its connection with the Lockport group, as may be seen on referring to wood-cut No. 13 of that group. Immediately above the bluish slaty shale which contains the concretionary mass, there are from seven to eight feet of green shale, having the same characters, excepting color, as the red ; upon which, is about five feet of red shale ;

then a green sandstone with green shale, varying in thickness from one and a half to three inches; again red shale two feet thick, followed by a band of green shale, and lastly red shale, which terminates this series.

The red shale on the west side of Oriskany creek, does not make its appearance until within two or three miles of the College, where it is well exposed, being the mass upon which the institution rests. In the ravine back of Dr. Noyes', a confirmation of its position, as regards the concretionary mass, may be obtained. The latter exists there, upon which the same green shale as at Hart's mill is placed, and then the red shale. From the College hill, the red shale is scarcely lost to view in its progress west, spreading out in descending from the hill-side, extending on both sides of the upper village of Vernon, and passing into Madison by Oneida Castle. In Madison, the Erie canal passes through the centre of the red shale; but in Onondaga and Cayuga, with some few exceptions, the red shale is on the north side of the canal, the other divisions of the group being on the south side. In all its range of surface and thickness, it shows but little variation, and in no part has a fossil yet been observed.

In several localities, the red shale shows numerous green spots, varying from an inch or less to several in diameter, which strongly contrast with the red ground in which they are placed. They were noticed near Hamilton college; near the salt spring, not far from Upper Vernon village; on the turnpike to the west of Oneida Castle; at the hill south of Lenox; on Canaseraga creek, near Storm's mill; at Salina, by the side of the canal on the road to Liverpool; and at the canal at Baldwinsville. At this latter place, many show a small round nucleus, whitish and earthy, as if decomposition had there existed. It is not easy to resist the impression that the green color is the result of a change in the red particles, the peroxide of iron being reduced to a protoxide, which analysis could readily determine. In order that this change should take place, an action or movement of the particles, like that which is necessary to form accretions, must first exist, with animal or vegetable matter to remove the excess of oxygen. Be the cause what it may, they are curious, and show the commencement of an action in a mass independent of an external cause, producing an important chemical result, as well as a marvellous one to the eye. It is by actions of this kind that the variations of color have been produced, which are noticed in boring into the red shale deposit.

The red shale, though of great extent, traversing the counties of Herkimer, Oneida, Madison, Onondaga and Cayuga, and presenting a thickness of from one to nearly five hundred feet, yet no where has a fossil been discovered in it, or a pebble, or any thing extraneous, excepting a few thin layers of sandstone, and its different colored shales and slate.

*Second Deposit.* This consists of shales, and calcareous slate of a light green and drab color, intermixing and alternating with the red shale at its lower part. On the road from Clockville to Lenox, descending the hill to the turnpike, is one of the best localities for observing the alternation of the different colored masses. Thus we have at the top of the series, green; then red under it; green; red; bluish; green and yellow, this latter by exposure to the air; then red and green layers, with a little white and greenish sandstone, being several repetitions of the two first; and finally red shale as the lowest visible mass.

The second deposit appears to be variable as to the color of its products. In some, red predominates; in others, the green, bluish and drab, and in some the red is wanting altogether. In this deposit, gypsum occurs in fibrous masses, either reddish or of a salmon color, which colors are peculiar to this deposit. The quantity of gypsum in this deposit appears to be small: all the quarries examined were in the third deposit. Recent excavations are the best for examining the products of this mass, in consequence of the ready alteration which some of the shales undergo by exposure to the air, from their friable or marly character.

This deposit is not founded upon any observations out of the three gypseous counties, Madison, Onondaga and Cayuga; though doubtless it exists at least through Oneida, but of little consequence in a practical point of view. In digging a well in the Indian reservation to the south of Vernon village, the products thrown out were those of the middle deposit; among which was fibrous gypsum: this was on a farm tenanted by Mr. Schoolcraft. The well was eighty feet deep, and no water was obtained. In the other parts of the same neighborhood (Baschard's Patent), gypsum of the same kind has been found on three farms belonging to Mr. Jacobs. The latter information was given by Mr. Salmon Case of Vernon. In no part of the whole range to the east of this locality, has any gypsum been found, though in such prodigious quantity to the west.

Near to Sodom lake, on the road from the foot of the lake to Manlius Centre, a well was excavated in this deposit at Eliakim Smith's. The rock of the well, and the products thrown out, were greenish and grey indurated marl, with white and red fibrous gypsum. There was no difference between the products of this well and those of a digging for salt water in the Salt valley near Abingdon, Virginia. The same products too were obtained in another well about fifty-five feet deep, on the road to Orville, about a mile east of Syracuse. Like products are observable in descending to Orville from the latter village. In all these localities, the parts excavated were below the level of the range worked for plaster.

The second and third deposits of the group have a common character, that of being exceedingly permeable to water. This fluid cannot be obtained on any of the hills composed of either mass, where the wells sink into them, unless sunk to the level of the water courses; a fact which readily explains the absence of all brine springs above the level of the country.

In one place only, I succeeded in finding fossils in the second deposit, consisting of cytherinæ about half the size of those in the groups above, and those below the salt group. They occur in a thin layer of calciferous slate, which makes a large portion of the third deposit. The locality is near the top of a hill going by the south side of the canal, from Jordan to Peru. In descending the hill towards the lower part, repeated alternations of red and green shales occur, characteristic of the second deposit.

*Third or Gypseous Deposit.* This is the most valuable deposit of the third district, and the most important, not only on account of its plaster beds, but because it is only in this deposit that we have positive evidence that salt has existed in this group in a solid state, and therefore the only source from whence the brine springs of Onondaga, Cayuga and Madison could have been derived, from what is known of the rocks of the district.

The great mass of the deposit, consists of rather soft yellowish or drab and brownish colored shale and slate, both argillaceous and calcareous, and of argillaceous and calcareous slaty and more compact masses which are hard, a brownish color predominating. The whole is usually denominated gypseous marl ; being earthy and indurated, slaty and compact. Some of the indurated and more solid kind, when weathered, presents a peculiar appearance like that of having been hacked by a cutting instrument, and with some regularity ; owing to cracks or joints in two directions, giving a rhombic surface ; which by solution and wear taking place at the cracks, and those not being continuous or regular as to distance, the appearance mentioned is produced. The stone readily breaks in the direction of the furrows or hacks, and the fracture shows stains or marks of infiltration.

When an acid is applied to the different associates of the gypsum, they do not effervesce in the free manner of purer limestone, but the effect is produced when in powder. It is highly probable that the greater number contain magnesia, which may cause the difference. This earth was found in considerable amount by Dr. Beck, in the upper part of the mass which encloses the lower range of plaster beds, on Nine-mile creek. Its presence is obvious from the serpentine near Syracuse, and from the cavities caused by the removal of epsom salts, which are numerous sbove the gypsum in several localities.

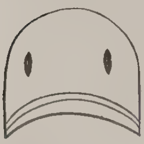
The dark color of the gypsum, and the brownish color of many of its associates, appear to be owing to carbonaceous matter, and not to metallic oxides, becoming lighter by long exposure. The greenish colored shale, so abundant usually in gypseous deposits, appears to be but an inconsiderable portion in the district ; owing to the dark color of its gypsum, and but few parts of the mass having recently been uncovered, and its ready change of color by the action of the weather.

At the east end of the district, the third deposit crops out of the hill-side to the north of Cherry-Valley village, as may be seen upon the road which leads to the Mohawk. The best place to examine it, is where the sulphur springs issue, and in the ravine to the west of the springs and the road. The lower mass is the thickest ; it is of a yellow or drab color, earthy, soft, calcareous, divisions not well defined, often with irregular cavities lined with minute crystals of carbonate of lime, or partially filled with the same. The mass exposed has evidently changed color. The sulphur springs flow from this mass ; above it is a more solid deposit, in thin layers, straight and striped like ribbons, bluish when fresh, changing gradually to a light brownish color, which finally the whole mass assumes. As the change first takes place at the lines of division, it gives a striped appearance to the mass. These two masses appear, with more or less variation, to be coëxtensive with the district. No fossils were seen in either at the east end, excepting a few indistinct fucoids ; but the upper mass is the position of the Eurypterus remipes, which is found to the north of Waterville. Above the upper deposit, there are irregular light-colored layers with Globuliform columnaria and other fossils, which belong to the water-lime group, or to an intermediate one which we do not attempt to establish. In the road and creek at Mr. Schawl's, west of the road which leads south to Richford springs, the two kinds also appear.

The same deposits appear in the hill-side at Crill's, where search was made for silver ore. The lower parts, which rest immediately upon the top of the sandstone of the Clinton group, are yellowish earthy layers, altered, and with the same kind of cavities as in the lower mass near Cherry-Valley. Higher up, at another excavation, there are thin calcareous layers or plates, upon the surface of which are small angular forms, which appear to have been caused by crystallization. The road, which lies a few rods to the west of the mine, affords an opportunity of seeing the different parts of the deposit as it exists to the east, and in considerable detail. The brook which passes by Wicks' store west of Crill's, is also a favorable point for observing some portions, such as the lower part with cavities usually partially and irregularly filled with semi-crystalline carbonate of lime, having a surface of a dark color. This may be seen within a foot of the whitish sandstone, or grey band, which forms the upper part of the Clinton group. Higher up, the hard straight-edged layers are seen, the blue color not having disappeared entirely; it is somewhat of a drab dove-color; above this is a greenish shale.

The deposit is readily traced from point to point west. Near Cedarville is the drab earthy limestone with needle-form cavities, in part filled with crystalline limestone, and which resembles the upper deposit of the group. At the north end of Paris hill, on the farm of Levi Comstock, the part which corresponds with the upper deposit at Cherry-Valley appears in the quarry upon the side-hill. There I found a well defined hopper cavity, the only one seen east of Madison county, and showing identity of position with the third deposit. In the same rock at the second furnace below Waterville, is the Eurypterus remipes, the only position of it in the district. The creek passes through low hills, the tops of which are about thirty feet above the water, and consist of the rock in question, which is best seen on the west side, where a small excavation has been made. It is in thin layers, with here and there a fragment of the Eurypterus, some fucoids and cytherinæ which were also noticed at Comstock's. Below these layers are others of a drab color, with cavities, and a more earthy deposit at the water's edge.

17.



Wood-cut No. 17 represents the head only of the Eurypterus remipes, in its natural size; it is wholly different from every thing else known, and therefore a characteristic. I have not heard of the discovery of more than one entire specimen, as but little of the rock which contained it has yet been excavated.

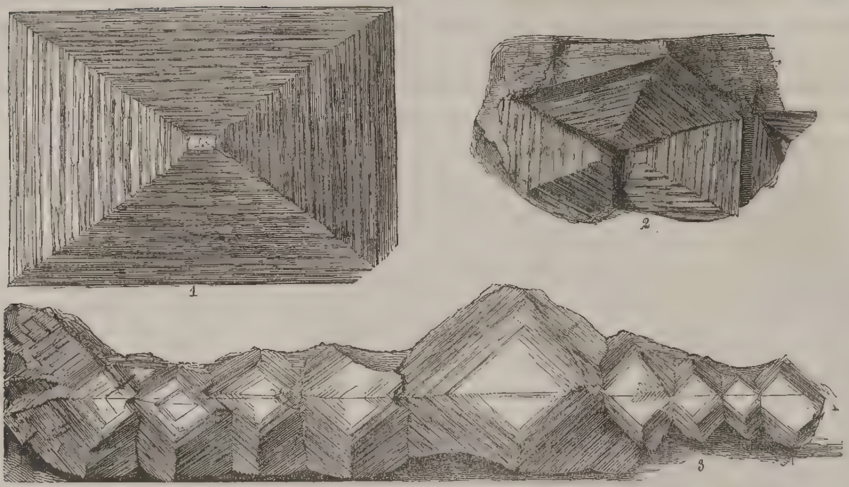
From Oriskany creek to Madison county, with the exception of the fibrous gypsum noticed at the Indian reservation, but little was seen of this part of the group which required to be recorded. In Madison, the massive gypsum commences, associated with a few other rocks not observed to the east, such as the vermicular rock, which tend to give greater variety of character to the group in that section of the district, and greater interest to the third deposit.

In the third district, the gypsum does not appear in layers or beds; on the contrary, it occurs in insulated masses, as though the particles of each mass had been attracted by a common centre, but greatly modified by disturbing causes, so that the forms which it assumed were irregular and not globular masses. In many localities, there appears to be two ranges of these masses, or *plaster beds*, as they are termed, generally separated by the vermicular rock, the hopper-shaped cavities, and other less characteristic masses. In no part of the range is there a vertical section, of any great height, of the gypseous masses exposed; and therefore there is no absolute certainty of their being in ranges, and of the number of ranges, though certain localities prove both; and the disposition of the whole third deposit to a stratiform arrangement favors a like state for the gypsum, but does not define the number of the ranges.

The next mass in importance to the gypsum geologically, is the *Vermicular limerock.* This rock is essentially calcareous, and was first made known by Prof. Eaton. It is a porous or cellular rock, strongly resembling porous or cellular lava. It derived its name from observing in it " several holes, which were still lined with a kind of tubular calcareous shell or crust, in some measure resembling the tubular covering of the Serpula, which is so often seen perforating coral rocks." In color it "is a dark-grey or blue rock, perforated every where with curvilinear holes; but very compact between the holes." The holes or cells vary from microscopic to half an inch in diameter; the cells generally are very irregular, and communicate in most instances with one another. Some are spherical, and contain spherical crusts. The resemblance of no small part of the rock to a porous lava is perfect; but should the cells in lava be caused by gaseous matter as is commonly supposed, these then had a different origin. In Bull's plaster quarry in the town of Lenox, the structure of the cells leave no doubt as to their mineral origin. The cells show that parts of the rock were disposed to separate into very thin layers which project into the cells, an effect wholly at variance with aëriform cavities, but evidently the result of the simultaneous forming of the rock, and of a soluble mineral, whose removal caused the cells in question. This view appears to be fully confirmed by the discovery in this rock of those forms which are due to common salt, showing that a soluble saline material had existed in it, had acquired shape in the rock, and had subsequently been dissolved, leaving a cavity, or cavities.

There are two masses of the vermicular rock, an upper and a lower one. The former commences at the ridge west of Oneida creek, and extends to Port Byron. Its thickness is about four feet; its pores or cavities are usually large. The lower mass is limited, having seen it only on Foot-street road near Syracuse, and in the road which goes from the turnpike to Bellisle south of the rail-road. Its pores are small, and its greatest thickness is about twenty feet.

18.



No. 1. A single hopper-shaped form from Bulls' quarry, town of Lenox, Madison county, and resembling those which are formed upon the surface of the solar salt pans.

No. 2. Exhibits three of the same forms, being one-half of a cube, their apex pointing to a common centre ; from Kelly's quarry in the same town.

No. 3. Shows a congeries of hoppers disposed in a line, the specimen from Bulls' quarry in Lenox. The line which crosses the range of crystals or forms, shows they were formed when the mass was in a measure desiccated or dried.

*Hopper-shaped Cavities.* The most interesting of all the products of the group are the hopper-shaped forms and cavities, the wood-cut showing three different appearances of them. These forms and cavities are of great importance, for they were produced by common salt, no other common soluble mineral presenting similar ones. They show that salt existed in the third deposit, and the position which they hold in the deposit should regulate all future borings that may be made for rock salt. These cavities are in shape like a mill hopper, whence their name. When salt is observed to crystallize, a cube first makes its appearance upon the surface of the brine ; this sinks gradually, as a series of similar cubes form around its outer border, being attached to its upper surface near its edge. When these are completed, the whole sinking as additional particles are added, another row of cubes are formed upon the first range ; and thus for many repetitions, until the density of the mass formed becomes greater than the liquid, when it falls to the bottom. When examined, being turned upside down, it shows a pyramid of regular steps, terminated by a cube ; and when its position is reversed, a form like the hopper of a mill : its perfection depending, as in all other cases, upon the absence of interfering or disturbing causes. No. 1 of the wood-cut shows a single pyramid or hopper, but the cubic arrangement is wholly indistinct.

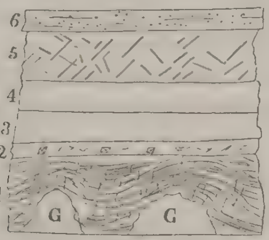
In all the localities where two ranges of plaster beds are seen, the hoppers occur between them, and between the two masses of vermicular rock : they are from one to three and more inches in diameter. Frequently six of the hoppers are joined by their apex, so as to present the skeleton of a cube, as may be seen by reference to No. 2; showing that all of them were not formed at the top of a liquid surface or water, but that they were the result of the desiccation of the mass in which they occur, the point of union being the point from whence the crystallization of their particles commenced. Should such have been the case, it is a fact of some consequence, being highly favorable to the existence of rock salt in this deposit. To these hopper cavities we shall again advert in another part of the report, merely stating that they are found in the gypseous shale or marl; in its more solid and slaty parts, and in the vermicular rock, between what we have considered to be the two ranges or series of plaster masses in the three counties.

Fossils are extremely rare in the whole of the group, having been found but in three or four localities, and at each one they were few in number. From the experiments of M. Beudant of Paris, that testaceous bodies cannot live in water saturated with gypsum, the inference might be, that such, with a few exceptions, was the condition of the water which deposited the materials of this group.

The whole of the gypsum in Madison county is confined to the towns of Lenox and Sullivan, with the exception of a small portion of the northeast of Smithfield, and a like small portion of the northwest of New-Stockbridge. In Lenox and Sullivan, the northern line of the plaster is near the turnpike road. Every quarry that was heard of, was noted in the report of 1839. A few only will be mentioned, so as to give an idea of their contents and the manner of arrangement to those unacquainted with that report.

Bull's quarry, to the right of the road from Sullivan to Clockville, is one of the most interest, though not of pecuniary value, from the thickness of the masses, which rest upon the plaster, all which must be removed before the gypsum can be taken out. Such quarries, therefore, are not so valuable as those where the gypsum is nearer to the surface. Were the overlying masses of the gypsum more solid, this mineral could be extracted in the ordinary mode of mining, but they appear to be generally too friable to admit of it. The annexed wood-cut, No. 19, represents a vertical section of this quarry.

19.



No. 1 consists of thin layers of a dark brownish color, somewhat hard; the letter G, two masses of gypsum. Here the part which encloses the gypsum shows that disposition so common to its layers when hard or solid, to form an arch over the gypsum, which, though not regular, is yet well defined. Where this exists, the mass or rock which forms the arch is full of cracks, owing to the force exerted by the plaster in its expansion upwards, and shows more or less consolidation of that part before the particles of plaster had collected together, and assumed the form in which we find them. Where the mass which encloses the gypsum is soft or friable, no arching appears, owing no doubt to the particles of the one taking the place of the other, both being in a yielding state.

No. 2, is light-colored, like No. 3, with hopper cavities; two feet thick.

No. 3. Thicker layers than No. 4, harder, not so dark colored, with hoppers; and at its intersection with the same, it is porous like the lower vermicular rock: four feet.

No. 4. Thin layers, brownish, with a few pores or cells, the whole appearing to be altered or decomposed: three feet.

No. 5. Slaty, variegated, grey and blue, striped, etc., with some fossils consisting of fucoids? resembling small spear-grass; they are charred, or in other words of a black color from coal or carbon: also the Lingula limosa, and two or three yet undescribed thin bivalve shells, whose character is very obscure, and which are of interest only from their rareness and position. Total thickness of this part, about ten feet.

No. 6. Porous bluish limestone rock (vermicular), the pores or cells larger than usual, and slightly compressed; these cells show that their origin is due to saline or solid, and not to gaseous matter as before stated: three feet thick. This terminates the mass, the third or upper alluvion of Chittenango covering the whole.

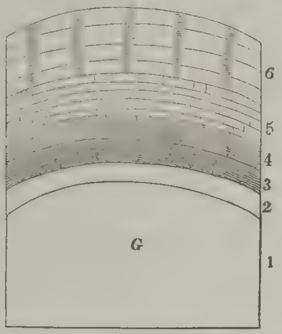
Not far from Bull's quarry is Mr. Brown's, about a mile and a quarter from Clockville, on the top of a low hill: the gypsum is very near the surface, and therefore more advantageously quarried. It presents a range of detached masses more or less rounded at the top, and with a flat surface below, enclosed in the usual thin layers of dark brownish and apparently a much altered rock. Above the gypsum are the layers No. 2 and 3 of Bull's quarry, with hoppers and pores.

The old Sullivan bed, now not worked, and near the turnpike gate, was the first plaster mass that was discovered. It no doubt contains all the members at Bull's, though not so prominently developed: it was the first one examined. The lower part is about twenty feet thick, being the part where the gypsum was quarried, none of it having been removed when visited. Above this was the mass which corresponds with No. 5 of Bull's quarry; then a bed of an olive color, much altered, two feet thick; upon which is the vermicular rock, about three feet thick, the pores large and numerous. In a quarry further east, the pores are both large and small.

The plaster hills range from east to west through the county, extending south of the turnpike from two to four miles. The hills are more or less round and short, rendering some portions of their plaster very accessible, the layers in which the masses exist having but a slight inclination. These latter observations apply also to the counties of Onondaga and Cayuga.

In Onondaga county, numerous quarries are opened along its whole range to the south of the Erie canal, the space occupied by its hills enlarging in width towards the west. A few only will be noticed. The one of greatest interest is Reed's and Brewster's on Butternut creek, below Jamesville; this, in the Report of 1839, was mentioned under the name of Hungerford's. A section of this quarry is given in wood-cut No. 20:

20.



The lower part G is a mass of gypsum over twelve feet wide, the bottom not exposed. It is the largest mass and the best quality of plaster seen east of Cayuga. Its color is not so dark as it usually is in other localities.

No. 2, of a dark brown color at the bottom, much broken, the parts re-cemented, with cavities or interstices: three feet thick.

No. 3. Thin fragile layers, with the irregular cavities noticed at the east end of the district: four feet.

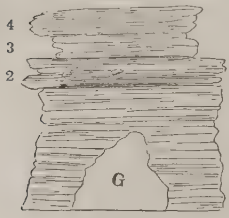
No. 4. Brown olive, thin layers, soft or tender: three feet.

No. 5. Compact layers of a dark drab, which are a water-lime, and are quarried a little beyond the plaster mass, and burnt for that purpose: five feet.

No. 6, consists of a few thick layers, of hard drab-colored, dull rock, resembling the water-lime of the upper group. It breaks into large irregular blocks. At intervals of a few feet, it shows a vertical series of cavities of sulphate of magnesia, the cavities disposed horizontally, strongly contrasting with the rock, being lined with black coloring matter in the state of coal or carbon. The cavities here are larger than elsewhere noticed in the district, some of them being four inches in length. These cavities in other localities appear at the intersection of layers, where the finer particles of rocks collect, and to which the divisions or layers are owing, and where moisture would always be in greater amount. Here it is different, and it is not easy to conceive how they were formed, unless joints existed above, by which water gradually found its way into the mass, attracting the salt which crystallized in the lines of percolation.

In this mass, and in this quarry, a few casts of the internal part of a small cyathophyllum were found, which, from its truncated apex, appears to be different from any of the other species. The same were also found in a similar rock in the fourth district.

21.



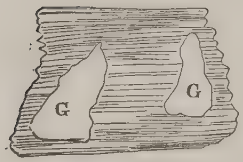
South of Syracuse, on the west side of the valley, not far from the mill, are Hunt's plaster beds. The lower part contains the gypsum, as represented in wood-cut No. 21, enclosed in layers of brownish and greenish shale, some more hard than others.

No. 2, consists of similar layers, with two small nodules of inferior plaster.

No. 3. Greenish layers : four feet thick.

No. 4. Thin yellowish layers : four feet. This section was taken from the south quarry.

22.



At the north quarry there are two masses uncovered, and their insulated character is well exposed as in the annexed wood-cut No. 22, G G being the gypseous masses, all which show the uniform manner in which the gypsum is found and formed, and that it exists in insular bodies, and not in regular beds or layers.

The greatest exposition of gypsum is along Nine-mile creek, from Camillus to a mile or two beyond the great embankment. The plaster beds were laid open in the grading of the railroad from Syracuse to Auburn. The lower part is the dark colored mass, which encloses the lower range of plaster beds. It shows in many points low undulations, probably the result of up-lifts caused by gypseous masses below the line and level of the railroad. This is the mass in which Dr. Beck found about twenty per cent of magnesia. It is about five feet thick, and about seventy feet above the valley.

No. 2. Thin layers of a lighter shade than the lower : four feet thick.

No. 3. Light greenish grey or yellow, with numerous hoppers, and usually arranged so as to form a cube ; at the west end of the section, they are often filled with lamellar transparent gypsum ; at the east end they are empty, but often coated with a crust of minute crystals of carbonate of lime : five feet.

No. 4. Rather a light-colored mass, with gypsum. At the upper end near the embankment, the gypseous masses are much larger than at the opposite end, some yielding from fifty to one hundred tons of plaster. Thickness of the deposit about twenty feet.

No. 5. Thin layers, but of variable thickness : fourteen feet.

No. 6. Vermicular rock, coëxtensive with the section, about four feet thick.

Some idea of the quantity of plaster in the range may be formed from the report of the Engineer of the Syracuse and Auburn railroad, upwards of forty thousand tons having been taken out from the hill-side between Camillus and Auburn, in a distance from five to six miles ; the amount of excavation in any one point being inconsiderable.

Very little gypsum is quarried in Cayuga county, excepting near the lake shore, to the north of Springport. The deposits extend along the lake and its outlet, for thirteen or fourteen miles. The quarries which furnish the whole of the plaster upon the lake, are about two miles north of the village of Springport, and are about five in number. The masses of plaster are beyond all comparison larger than those to the north and the east, and of better quality. The masses have all been denuded, for they are surrounded and covered by the most modern or the upper alluvion of Chittenango, presenting none of their terminal associates, if we except a portion of the mass in which they were enveloped, whose layers cover portions of the gypsum. This is blackish in color, earthy in aspect, often variegated like the gypsum, contains sometimes lamellar gypsum, and more rarely a little pure sulphur. It has the appearance of an impure gypsum, and is considered by the quarrymen to be an incipient plaster, requiring time only to make it perfect. The gypseous masses there are all in a low position, some of them several feet below the surface of the lake. They show a thickness of from fifteen to twenty-five feet, and some of them are opened along a line of two and three hundred feet. The quarries furnish about ten thousand tons yearly; the price of which, delivered at the head of the lake, is from one dollar and fifty cents to two dollars the ton. A considerable portion of this plaster is sent to Pennsylvania, by the Ithaca and Owego railroad and the Susquehannah river.

At Cayuga bridge, the plaster appears both above and below the bridge. The layers which cover the masses are soft and light-colored, showing a few of the small irregular cavities coated with dark-colored carbonate of lime, which, in the three plaster counties, are more commonly seen with the upper range of gypsum, and accompanying the shale of the group throughout the third district.

*The Fourth or Magnesian Deposit*, so called from presenting the needle-form cavities, or fine striated columnar appearance, caused by the crystallization of sulphate of magnesia before the rock had assumed its solid state. These cavities were noticed the first year of the survey, in the brownish drab rocks at Seneca falls, which cover the gypsum. They were next seen in the same position as inferred, south of the plaster masses on the road from Cayuga bridge to Springport, the rock being of the same kind; that is, a brown drab in color, solid, dull and fine grained. This same mass appears just beyond the north point of the curve of Springport on the lake, rising a few feet above the water, and dipping to the south apparently, so as to pass under the water-lime group, a part of which appears at the point. They also appear in the foundation of the mill at Troopsville. Some of the cavities are three inches in length; the upper layer, which contains them, is brownish, and the lower one bluish, the latter with more lime than usual, and its fracture conchoidal. But two layers only are exposed. The same cavities also appear below the water-lime group, by the side of Split-rock railroad near Syracuse. The rock is in thin layers, and the cavities occur at the joints, etc.; under which there is a light tea-colored shaly mass.

The mass at Reed's and Brewster's already noticed, may be referred to this deposit; and also those near Cedarville in Herkimer county. The difference between the third and fourth deposits consists in the presence of these peculiar cavities in the latter, and the layers being more solid and thick, the softer marls, etc. having terminated with the third deposit.

These cavities are not confined to this rock; they occur abundantly in the Niagara limestone, and in some others in the third district, but less distinctly. As their origin is due to sulphate of magnesia, for the sake of brevity they might be termed *epsomites*. The carbon which usually lines the cavities, shows that the liquid which held the salt in solution contained bituminous matter, the salt ejecting its particles in the act of assuming form, as we find in the purification of acetic acid when obtained from the distillation of wood. It is highly probable that the brown color, so common to some of the gypseous masses, may be due to bituminous matter.

The cavities or epsomites are found in the western country in greater length than in New-York, having met with some in Kentucky which were over six inches long. Dr. Locke, in the American Journal of Science and Arts for January, 1842, has given a description and a drawing of some beautiful forms discovered in the Mammoth cave of Kentucky, which doubtless would be ascribed to epsom salts, were their material not gypsum, which is white and semi-transparent, from whence in part their beauty. In several localities in New-York, the cavities are filled with white crystalline carbonate of lime; and they have also been seen with the curl which takes place when the action is too great on one side, of which there are specimens in the collection, requiring but the removal of their matrix to correspond in all essentials but composition with those of the Great cave. In the Report of 1838, the fact of the appearance of epsom salts upon a specimen from the falls of Niagara, was significant of their origin; and the occurrence of the same salt in the cave where those described by Dr. Locke were found, would show a like connection and like origin, were it not for their composition, and that the fibrous form is one of the common ones of gypsum. Should the forms in the cave be the result of an original action or crystallization of gypsum, and not of a substitution of gypseous particles for those of sulphate of magnesia, either of composition which took place in the cavities, or otherwise, then two causes of their production will be known; and some character must be discovered to distinguish the one kind from the other, if deemed important. These cavities and forms are analogous to those beautiful productions of frost often seen in wet and loose soil, when a sudden and considerable fall of temperature takes place, producing a rapid crystallization.

The degree of dip of the group at Syracuse, being an object of practical importance, was in a measure ascertained by a level kindly undertaken by Mr. Hutchinson, formerly engineer of that section of the canal. The points chosen for the purpose, were the hill at Salina village where the porous rock appears; and that part of the road to Onondaga hollow, where the same rock also shows itself by the road side: The height of the first point above Onondaga lake was 108.04 feet, and that of the latter 34.10 feet, the distance being 2.51 miles from each other, making the dip about 25½ feet to the mile; which nearly accords with a measurement of dip of the corniferous limestone in Oneida county, which was 27 feet in the same distance. The direction between the two points in Onondaga being S. 15° W., and not S.W., which is nearer the direction of the group, makes the observed dip rather less than the real one.

The group, as a whole, presents the same order of saline deposits, including iron, observable in the salt-pans where solar evaporation is used. The first deposit in the pans is ferruginous, being red oxide of iron, and staining of a red color whatever it falls upon; the next deposit which takes place is the gypsum ; the third is the common salt, the magnesian salt remaining in solution. The group shows first a thick mass colored red with iron, being its red shale ; above which are the gypseous masses ; towards the upper part of which, are the salt cavities ; the sulphate of magnesia exists above the whole of those deposits, its existence there being manifested by the needle-form cavities.

Near Syracuse, at the Hopper locality in the Onondaga valley, and at Chittenango, &c., surfaces are seen which show an angular configuration, somewhat resembling those leaves whose mid-ribs are straight, and inclined at an angle of about 35° from the stem. These were noticed by Prof. Eaton in his survey of the Erie canal, having seen some which were thrown out in digging a well at Syracuse ; the cause of which was properly referred by him to crystallization.

On the canal near Lake Sodom, layers of a similar kind, but belonging to a lower deposit, show numerous cavities not unlike those made by a small chisel of about three-fourths of an inch in width ; some of them are single, and others cross each other as though struck at random. In the surface also of the calciferous slate above the gypseous deposit at Crill's in the town of Stark, there are small impressions in relief, the best defined of which are like obtuse Indian arrow heads, being triangular, with the sides somewhat curved ; these were previously noticed, but not their forms.

*Metamorphic Rock.* On the Foot-street road to the east of Syracuse, between the two porous masses, there is a highly interesting exposition of this kind. It appears in the side-hill to the south of the road, and crosses the road, extending north for many rods. The great mass of entirely altered rock is a well characterized serpentine, especially when examined by a microscope. The color is a very dark or blackish green, becoming yellowish by alteration, a large portion of it being in a friable and decomposed state. By the aid of the glass it shows innumerable points of precious serpentine, and also particles of a yellow or golden color, some of which appear to be mica ; there are others of the red color of bloodstone, and again some like devitrifications. It also shows well characterized mica of a white or light color, and again of a black color. In a few specimens, there was an accumulation of black mica in small particles, putting on the aspect of a primary mass. One or two well formed accretions of granite were found, in one of which hornblende took the place of mica, forming a sienite, the mineral character perfect, the mode of aggregation also, and the identity with the primary rock of like kind equally so. Some of the calcareous portions showed a crystalline grain of a light drab color, beautifully veined and streaked with light bluish shale, forming a handsome marble ; these and other calcareous parts formed or rather existed as accretions or nodules, enveloped by the serpentine. The slaty portions of the gypseous group near the altered rock, show the influence of the cause of those products, being more hard and crystalline. Sulphate of strontian is one of the products also ; a very beautiful specimen of this mineral was found near the hill, and is in the collection of the Syracuse Academy.

The great interest of all these metamorphic products, is that they have not been caused by a dry heat, or fire, no evidence of the kind existing; nor is any needed to effect the change there observed, though it can, and has, and does produce the same results. All that is required, is the presence of the elements of the products observed at Syracuse, and in a state admitting of solution and of moisture, to which every degree of heat added, would greatly aid their mutual action upon each other; and from solution, crystallization would take place, and thus metamorphic products or rocks would be formed, no igneous action commonly so called being requisite, but a thermal one only.

## 13. WATER-LIME GROUP.

*Water-lime Group of Manlius. Hydraulic Limerock of Eaton.*

(Part of No. 6. Pennsylvania Survey.)

This group takes its name from the earthy drab-colored limestone, from which all the water-lime in the district south of the Erie canal, with one exception, is manufactured. It consists generally of dark blue limestone, and usually of two layers of drab or water-limestone; the two always separated by an intervening mass of blue. The group is well defined, and is readily recognized in this State and in Pennsylvania, by its mineral nature, its fossils in particular, and by its position. It extends through the district with a thickness of not less than thirty feet, often attaining to a hundred or more.

Some of the layers of blue limestone have been deposited in the state of fine sediment, or rather a sediment mixed with a calcareous precipitate, showing a striped or ribbony appearance, and separating into thin straight courses in accordance with the stripes.

In general the layers are extremely regular and well defined, usually about three feet thick, but often four and even thicker. The courses into which the layers are sometimes divided, instead of an even, show a crenulated or notched surface, like the sutures of a skull; the two surfaces interlocking with each other, and the projecting parts showing a fibrous structure, caused in part by the crystallization of epsom salts, this effect taking place where the impurities are in greatest amount in the rock. The layers and courses in the rock were caused by the impurities which they contained, collecting in the seams or divisions, whilst the rock admitted of the permeation of moisture or water.

One of the layers, usually from four to five feet in thickness, is traversed by oblique cracks in at least three directions, breaking the mass into irregular parts or fragments: this layer is very fine-grained. It sometimes contains irregular nodules of flint; and when these are absent, which is usually the case, it makes the whitest lime, and requires less fuel to burn a given measure of it than of any of the other limestone rocks.

The manner in which this layer is fractured or cracked, shows the absence of clay, the tendency of which is to separate in layers, and that its impurities are siliceous, and that the silex existed in that state in which the tendency to accretion predominated. Even where the siliceous nodules or flint are not visible, there are parts of the layer in certain localities which show themselves as core, after the stone is burnt.

Along the whole of the outcrop of these upper or Helderberg limestone rocks and groups, wherever this layer appears in the district, if it contains no nodules of flint, it is the one which is burnt for lime; a circumstance which shows the sagacity of the limeburners.

In some parts of the west end of the district, some of the layers have abounded in Columnaria, the species yet undetermined; their character, generally obliterated; the space they occupied, in part occupied by flint, which by long exposure, and the removal of the limestone in part, gives to the layers a ragged and uncouth appearance.

West of Oneida creek, the portion burnt for water-lime consists of two layers of a drab color, which appear to be coëxtensive with the group. It is dull in its fracture, and composed of minute grains, with usually but a few lines of division. The upper layer is somewhat *shelly*, as it is termed, breaking into irregular thin curved fragments or plates. Less heat is required to burn the upper than the lower layer. Where the two kinds are burnt in the same kiln, the one from the lower layer is placed at the bottom, and the other above it. About sixteen cords of wood are required to burn one thousand bushels of water limestone in the common kilns.

To those unacquainted with the tests whereby a water-lime is known, the same being now an object of great importance from the many uses to which it may be applied, it may be well to state, that the stone must not slake when burnt; when ground, it must harden or set when mixed with water; and when set, it should remain so under water, the goodness depending upon the hardness or cohesion when set.

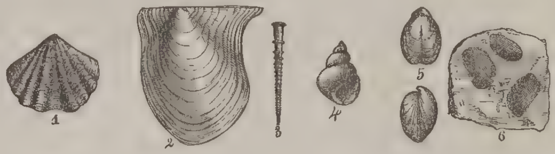
The line of separation between the water-lime group, and the Onondaga salt group, is rather well defined at the eastern end of the district. There a brownish impure limestone is seen, often mottled, containing columnariæ of a somewhat spherical form, and about the size of an inch or more; also a few encrinital fragments, and a small orthocera, the species not named. This is the mass which separates the two groups, and forms the base of the water-lime group. At the west end of the district, the opportunities to obtain a knowledge of the intermediate mass are but few and imperfect. The best place is on the road from Jamesville, on the east side of the creek, not far from Dunlop's mill. A number of layers appear of a brownish drab color, some of them containing very white lamellar carbonate of lime in small globular particles. No fossils were seen, but little of the rock being exposed, and therefore no definite result obtained.

The same columnaria which exists at the base of the group, occurs at the top of the group immediately under the pentamerus limestone. This is most obvious in the town of Warren, south of Mr. Crugar's, in the road to Richford springs. The columnaria occurs in a brown mottled very impure limestone, somewhat resembling the one at its base. The same fossil also exists in the upper layer of the group, at the quarry south of Chittenango, &c.

This group is readily recognized by its fossils, in every part of the State where it exists, and in Pennsylvania also; but beyond these two States, it has not yet been recognized.

The wood-cut below exhibits six of the fossils of this group; some of which, such as Nos. 1, 3 and 6, are extremely abundant, and Nos. 1 to 5 have only been found in this group.

23.



No. 1. Plicated orthis (O. plicata).
2. Rugous avicula (A. rugosa).
3. Ornated tentaculites (T. ornatus).
No. 4. Antique littorina (L. antiqua).
5. Sulcated atrypa (A. sulcata).
6. Elevated cytherina (C. alta).

These are but a few of the different kinds of fossils which were found in this group; but from the frequent, nay almost constant association of Nos. 1, 2 and 6, it was readily recognized by these three alone. Among the others not figured, it may be well to mention that some localities abound in a strophomena which appears to be peculiar to the group; that it was also the only position in the district where a catenipora, probably the labyrinthica of Goldfuss, was found; and that it contains also an agnostis, which may be the piciformis, or *Pea-shaped agnostis;* the details of all which fossils are left for the report upon that subject.

The water-lime group is one of those coëxtensive with the Helderberg range. Throughout its range in the district, it contains the drab layers which constitute the water-lime proper; but no water-lime is made to the east of Madison county, as before mentioned. To the east, the drab-colored portions are fossiliferous; rarely, even in parts, so pure; their color of a darker yellow by alteration, often brownish; and they appear evidently to have been formed under somewhat different circumstances from those which appear to correspond with them to the west. The layer also which is so much used through Madison, Onondaga and Cayuga, to make common lime, is obscure to the east of the above named counties.

*Localities.* The group appears by the road-side, ascending the Helderberg range to Cherry-Valley from Fort-Plain, showing the dark blue layers with numerous specimens of Plicated orthis, cytherinæ and also tentaculites. The light-coloured and more impure layers appear at a lower level, in the ravine or gully to the right of the road. The first or lowest portion consists of irregular layers, with Globuliform columnaria; above which there is a drab-colored series, followed by the upper blue or dark-colored ones.

The group forms the head of the falls near Judd's mill, to the left of the road, and north of the village of Cherry-Valley.

There are few rocks of the Helderberg range, exposed in so many points as the water-lime group; a few of the most prominent only will be mentioned, in order to show their precise range.

The next place of interest is on the side-hill of Smith's farm, on the road from Fort-Plain to Richford Springs, where a quarry is opened in the lower part. The layers are of a drab color, and of a darker yellow where altered. It is the only part of the district where the Catenipora, supposed to be the labyrinthica, was found. A columnaria also occurs in the mass, a few specimens of which were two feet in diameter, and other fossils are associated with them.

Further west, back of the adit where gypsum occurs in the town of Stark, in ascending the hill by the road, the same drab-colored layers with globular columnariæ are seen, above which are the usual blackish-blue straight layers of the group, with numerous cytherinæ, and also the Plicated orthis.

In the low hill-side at Mr. Crugar's, the upper part only appears. It contains, in one or two layers, numerous casts of the internal part of the Antique littorina, or a shell which resembles it; and the two usual associates, the Plicated orthis and the Elevated cytherina.

At Harvey Gitman's in the town of Columbia, it shows drab and blue layers, the former somewhat brownish, and others which alter to a deep brownish yellow. It is quite fossiliferous; a greater number of different kinds were found here than in any other part of the group, among which were the Plicated orthis, Rugous avicula, cytherinæ, columnariæ, strophomenæ, an atrypa, and parts of a calymene and an asaphus.

It is considerably exposed through the town of Litchfield, near Cedarville, and further west. The casts of the Antique? littorina again appear in the hill-side on Mr. Brown's farm, between Cedarville and Wetmore's public house.

In Oneida county, the first locality of note is the one below the village of Paris-hill, ascending from Sauquoit creek by the road to the north of Swift creek, or Rogers' machine factory. The lower layers are thin, bluish, but become earthy by exposure; above which, are the usual dark blue ones with cytherinæ, etc. which are burnt for lime. The group makes its appearance on the side-hill of the same projecting mass, to the northwest of Eastman quarry, the hill facing Oriskany valley.

The group forms the high projecting point south of Hamilton College, and is uncovered in many places on the surface of the hill south towards Oriskany falls. Towards the south part, it is covered by higher masses. At the falls it shows, at the water's edge in the canal, a drab-colored mass; above which are the blue layers, containing Plicated orthis, cytherinæ, tentaculites, casts of the Antique littorina, Rugous avicula, an orthocera, and the Peaform? agnostis. At this locality in particular, and in others to the east, but not much observed to the west, parts of the mass are full of small irregular cavities, rarely exceeding a quarter of an inch in diameter; the rock harsh to the touch, showing evidently that a soluble mineral once occupied the cavities.

In Oneida valley, on the east side, it has been quarried in several places, and forms also the base of the falls of Oneida creek on the west side. It forms the great mass of the gulph at the falls of Perryville, and also that of Cazenovia falls on Chittenango creek, showing a thickness of over one hundred feet.

It faces the hill to the south of Chittenango village, on the road to Cazenovia, and is there quarried and burnt for water-lime. At the quarry where the upper layers are exposed, the lowest one is drab or light grey, mottled with blue, divided into two courses, and again subdivided, but not regularly: four feet thick. This is burnt for water lime.

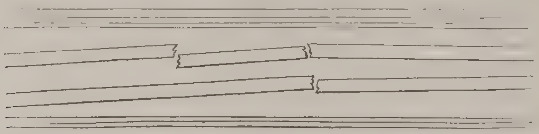
Above: Blue layer, striped; showing courses by exposure and fracture; surface often notched; the sides and elevations showing a fibrous structure, and coated with a black or brownish glazing: four feet.

The 3d layer is also burnt for water lime; it is of a light drab, in thin irregular courses or other divisions, the effect of weathering from an original cause: over three feet.

4th. Irregularly divided by oblique cracks, usually in three directions; the outside makes good lime, but there is too often a hard core which renders it useless for burning: five feet thick.

5th. This layer is in very thin courses, with short curved surfaces, a structure very common to much of the limestone through Oneida, that of Oriskany falls being a remarkable example. This layer terminates the group at this place.

24.



The preceding wood-cut is a representation of two thin layers observed at this quarry, making a part of one of the large layers of water-lime. They were not much over an inch thick, and evidently had hardened or set before the enveloping part had assumed the same state. A reference was made to this fact in the Report of 1839, when explaining the cause of the arching observed above some of the masses of gypsum, and its absence in others. The arching existed where the part over the gypsum was solid; if otherwise, there was none, showing that the fixation or consolidation of the arched part took place before the accretion of the gypseous particles, the expanding of which raised the solid or hardened part; and where this did not exist, the parts above must have subsided to where there was less pressure.

The next point of interest is in Onondaga county, near Manlius square, at about three-fourths of a mile to the southwest of the village. It shows the same masses as at Chittenango, but differs a little in quality: the lower layer contains a larger proportion of ordinary limestone, free from all accretions of a siliceous nature, and therefore makes a first quality of lime.

It forms the well known falls of Manlius, whose height appeared to be about forty feet.

At Brown's saw-mill, rather more than a mile to the south of the village, there is the greatest exposition of one of the layers of drab or water-limestone proper, which exists in the district, lying very near the surface, covered only by a little soil, and exposed in many parts, particularly in the creek near the mill. It has been quarried for enclosures only. It is of the right color and grain, and as far as those characters could be relied upon, appeared to be of the best quality. It contains geodes or cavities, either lined or filled with white sulphate of strontian, with some purple fluate of lime, and occasionally some gypsum. It appeared to be the upper bed, and its thickness is about four feet.

Butternut creek, below Jamesville, offers the best point for showing the connecting part of the water-lime and Onondaga salt groups; but more quarrying is required at the junction to show it clearly. Not far from Dunlop's mill, on the east side of the creek, the upper layer, exposed above the kiln, is one of the drab layers, and is quarried for burning; under it is a blue one, with Plicated orthis; lower down, near the kiln, are other layers, the second of which contains replaced corallines; under these layers is a mottled one; below which, and the last to be seen at the quarry, is a layer resembling water-lime, but of a darker color than usual. Between that quarry and the plaster quarry of Reed and Brewster, other layers appear in the road; the first of which, in the descending order, is of a bluish color, breaking irregularly; under it is a softer one of a lighter color, rendered yellow by long exposure; then a drab limestone resembling the water-lime, full of round cavities filled with white lamellar carbonate of lime, with some sulphate of strontian; under which was a similar mass as to color, but containing epsomite cavities replaced with white limestone, which appeared to extend to the plaster quarry, and to form its terminal part.

In Onondaga valley, the upper part of the group is exposed by the road-side ascending the hill towards Lafayette, and at the quarry a few rods to the east. The upper layer, which is under the

1. Onondaga limestone, and some disintegrated Oriskany sandstone, shows a striped, but good and light-colored limestone.
2. The next below, full of replaced columnariæ, and some casts of Antique littorina: seven feet thick.
3. Layer in this division: three feet thick.
4, 5. Two layers, each about five feet, with diagonal cracks, and burnt for lime; the lower layer is the best; the upper contains replaced columnariæ.
6. Layer of water-lime.
7. Layer of blue limestone, of a dark color.
8. Layer of water-lime, of a darker color than the upper one.

The group is well exposed by the side of the railroad near Split-rock quarry: there the connection with the group below it can be seen to a large extent. The upper layers are quarried for building at Syracuse; they are striped, and contain Plicated orthis, Rugous avicula, cytherinæ, etc. The bottom layer, upon which the group rests, is similar to the one which covers the plaster quarry in Butternut creek.

The group appears under the whole range of quarries of the Onondaga limestone, forming a cliff in which parts favorable for examination are exposed. The upper layers contain many individuals of the strophomena of the group.

Portions of the lower part of the group, and some of the upper, are favorably exposed in the valley of Nine-mile creek, below Marcellus village; and also along the outlet of Skaneateles lake, where water-limestone is quarried for enclosures, but not for burning. Good specimens of the Antique littorina are more numerous in that direction, than in any other locality met with.

There is an extensive exposition of the upper layers by the hill-side facing Auburn, commencing at some distance to the east by north of the village. They are quarried at the third opening at Beck's quarry. Three layers being extracted, the upper one, which is immediately below the Oriskany sandstone, is rejected; the two lower ones are burnt for lime.

Another point is at the ledge to the north of the factory, by the side of the outlet. It forms the cliff extending round towards Springport, and is favorably exposed in many points; one of which is on the road to Cayuga bridge at the descent of the ridge. The top shows some portion of the Onondaga on the left, and the water-lime group on the right. This is one of the localities of the Sulcated atrypa.

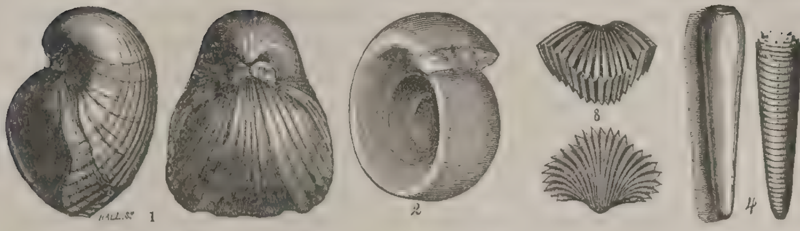
Another favorable exposition is the quarry belonging to Mr. Yawger? to the right of the road from Auburn to Springport. There the blue is burnt for lime, and good water-limestone exists with it, which is not yet used.

At Springport, it appears in the brook at the village, showing one of the layers of water-lime. It is quarried at Blanding's and burnt for lime, at the side of the lake to the southwest of the village, being the extreme quarry there opened. The group finally disappears under the lake, at the point of land to the southwest of the quarry.

## 14. PENTAMERUS LIMESTONE.

### (Part of No. 6. Pennsylvania Survey.)

25.



No. 1. Galeated pentamerus (P. galeatus). No. 3. Lacunose atrypa (A. lacunosa).
2. Deep euomphalus (E. profundus). 4. Gebhard's lepocrinites (L. gebhardi.)
All these fossils commenced in the district with this rock, and ended with it.

This limestone takes its name from the Pentamerus galeatus, or *Helmet pentamerus*, for which *Galeated pentamerus* is substituted on the authority of Noah Webster. This fossil is well figured in No. 1 of the preceding wood-cut, which exhibits two views of it. It abounds in this rock, and in the district is confined exclusively to it. In some localities this fossil is in immense numbers, and is considered by Mr. Conrad to be the same as the one figured under the name of *Atrypa galeatus* by Mr. Murchison, whence its specific name. None of the English specimens have yet been received, and a doubt may be entertained as to identity. They make, however, a very near approach to each other externally; and if not the same, they may be considered as geographical substitutes, should their internal structure be the same. There can be no doubt of the American fossil being a Pentamerus, as defined; but of the English one, it can not so positively be affirmed. The genus Pentamerus is one which is readily recognized by its internal structure; separating at the beak, for some distance, into five parts with smooth surfaces.

No. 2 of the wood-cut is peculiar to this rock, but it is rather a rare fossil.

No. 3 is also somewhat rare, especially in the third district. It is important to give a good figure of this fossil, as the name appears to be applied in Europe to a fossil like this, and to the Atrypa wilsoni also of this rock.

No. 4, shows two views of the lower part of the Gebhard lepocrinites: One in the perfect state, wherein the internal structure is not evident; the other shows the internal structure, which consists of a series of circular disks or plates placed one upon the other: these are not evident unless acted upon by the weather. It has a slight depression at the larger end, like the one in the spine of an echinus, and by which it was attached to the upper part of the singular fossil of which it forms a part.

The Pentamerus limestone enters from the first district with considerable thickness, and continues to the falls of Oneida creek, beyond which it was not distinctly recognized. Nor is there any chance for its existence from the west end of Madison county, to Cayuga lake; for from thence the water-lime group, the Oriskany sandstone, and the Onondaga limestone come together, to the exclusion of all the rocks intermediate to the water-lime group and the Oriskany sandstone which are found at the east. It is rarely pure, being more or less mixed with black shale, which gives a dark color to the rock, being usually a black grey. In grain it is crystalline. It is in layers, but the lines of division are not straight, and the surface not even. The whole mass has a rough appearance; it does not make a good building stone, unless for cellar walls or field enclosures, owing to its accretionary character. Carbonate of iron of a deep orange or brown color, but in very small quantity, is frequently seen in this rock. From observations at the hill south of Sharon springs in the first district, from the hill at the north end of Cherry-Valley, and from the road from Cooperstown to Fort-Plain, there are three divisions in this mass according to the fossil character. In the descending order, there are first, some layers with nodules of flint, the nodules not constant; below which, a series with the Galeated pentamerus in considerable number, with some other fossils, such as the Deep euomphalus, (No. 2 of the wood-cut); under these, another series with Gebhard's lepocrinites; and then a third, with the Galeated pentamerus, showing a separation of the pentamerus layers by the Lepocrinites gebhardi. At Schoharie the two lower divisions only exist, making the middle one the line between the pentamerus rock and the succeeding one; for which reason the above detail is given.

The Galeated pentamerus and Gebhard's lepocrinites are in very great abundance; their fixed position, appearing with this limestone and disappearing totally with it, would be a great marvel, if geology did not consist in great part of a series of such marvels.

The pentamerus limestone may be seen south of Mr. Cruger's in the town of Warren, resting upon a mottled brown and blackish limestone full of columnariæ, which, so far as I am able to judge from the specimens collected, do not differ in their internal structure from those at the base of the group. No other rock is visible at the place, all being hidden by soil. The water-lime group, however, is in the same hill-side to the east and north, at a lower level.

North of the village of Cherry-Valley, the pentamerus limestone may be seen in many points. It forms the head of the falls at Judd's mill, and is uncovered for some distance on the road to Fort-Plain. From its hardness, it often appears forming the hill-side through the north part of Otsego, and is the surface rock in the towns of Stark, Warren and Columbia in Herkimer county; the pentamerus shells being very abundant in Herkimer, the most perfect being found about two miles from Petrie's corners on the road to Cedarville. From Herkimer to Casety hollow they are rare, but reäppear again in the ridge descending by the road from Augusta village to Munsville. The last place where they were found with certainty, was at the falls of Oneida creek below Foster's mill, the rock terminating before reaching the longitude of Chittenango village.

At the falls of Chittenango creek below Cazenovia, just under the Onondaga and Oriskany sandstone, a layer or two of impure limestone is seen, containing rounded grains of white transparent quartz, with some imperfect shells which resemble the Galeated pentamerus; being all that was seen, which appeared to belong to this rock in Madison county, to the west of the falls of Oneida creek.

There are several other fossils associated with the pentamerus, and it may be well to note two or three of them. It contains two atrypæ, of a kind which first appears in this district and State in this rock, and there are three in all. Beyond this State there are others, one of which exists in a lower position in Ohio and Indiana, being the A. capax of Conrad; the third is confined to the Tully limestone, being the A. cuboides. The two which are found in the pentamerus limestone, closely resemble the Terebratula wilsoni as figured by the English geologists. The one given by Mr. Lyell in the Boston edition of his Geology, will be the Wilson atrypa; and the one in Mr. Murchison's work, the Inflated atrypa (A. inflata). The ribs or ridges in this division of atrypæ are divided into three portions; those of the middle one in each of the New-York species, are seven in number, which would appear also to be the number in those of Europe.

The Atrypa lacunosa (No. 3 of the wood-cut), so named by Mr. Conrad from identity with the one of Europe, is readily distinguished from the others by its high and sharp ridges and deep furrows, all which pass under the beak with graceful curves.

The pentamerus limestone is burnt for lime in several places along its range. A number of kilns may be seen by the road-side in the town of Springfield, &c.

The thickness of this rock was not ascertained by measurement. Its maximum is in Otsego county, where it can not be less than eighty feet. It diminishes towards the west, being not much over ten feet at Oneida creek, and the limit there is not so well defined as at the east.

The following list presents all the fossils belonging to this rock, which have been identified and named by Mr. Conrad up to this time.

### Testacea or Shells.

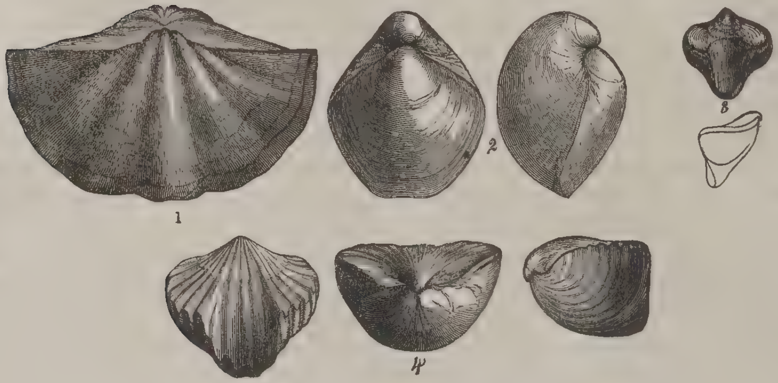
Pentamerus galeatus.
Atrypa lacunosa.
— semiplicata.
Euomphalus profundus.
Strophomena varistriata.
Strophomena rectilateris.
— impressa.
— elongata.
Avicula naviformis.
— manticula.

## 15. CATSKILL SHALY LIMESTONE.

*Delthyris Shaly Limestone, and Scutella Limestone of the Reports.*

(Part of No. 6. Pennsylvania Survey.)

26



No. 1. Big-ribbed delthyris (D. macropleura).
2. Smooth atrypa (A. lævis).
No. 3. Singular atrypa (A. singularis).
4. Medial atrypa (A. medialis).

The present name of this rock is taken from Catskill creek, in the first district, near the town of Madison, Greene county, by the side of the railroad, where for a long distance it is exposed to great advantage for examination. The name is objectionable, but it is no easy matter to find one in the State which will be less so.

In the first district this rock is a thick mass. The lower part is usually a mixture of dark bluish-grey shale, which generally changes to a drab color, and of a fine grained blue limestone. The upper part, at Catskill creek and the Helderberg, is a very light grey coarse crystalline limestone, which abounds in a discoidal shaped fossil, about two inches in diameter, resembling a scutella, but which appears to be the pelvis of an encrinite. The difference between the upper and the lower part of the mass in the first district, gave rise to the two divisions into which it was divided in the annual reports; the encrinal pelvis existing in the upper part of the mass, and in the first district, in great abundance. It is remarkably prolific in fossils not only as to individuals, but of different kinds as to species, genera, etc.; the greater number of which are characteristic of it.

In the third district the rock is not so thick, the shale diminishes in amount, and disappears in Herkimer county; but the limestone portion continues to the east end of Madison county, beyond which it has no existence. Much the best development of this rock exists in the first district as to thickness, and fossils as to kinds. It is, however, well exhibited to the north of Cherry-Valley in ascending the hill or ridge, and in the road to Judd's mill, etc.; also through the towns of Warren and Columbia in Herkimer county. In Oneida county, but little comparatively is seen, the ridge being broken by the Sauquoit and other creeks, and the limestone concealed by its overlying rocks, and by drift and soil.

It appears, however, to be in considerable thickness at Oriskany falls; the greater part a pretty good limestone, parts only showing admixture of a brown or lighter colored shale where long weathered. Fossils are not numerous at this locality, excepting in the upper part, just below the Oriskany sandstone. From the absence of shale, and from the fossils in this rock and in the pentamerus under it being but few comparatively in number, the line of division is quite obscure at the falls; so much so, that no attempt was made to ascertain its existence; whereas at the east, it is well defined, the shaly layers commencing with the Catskill creek rock, and their fossils being in profusion.

The Catskill shaly limestone, as repects fossils, is of great interest; they are so numerous, and so varied; and no doubt when the divisions of the Transition class are more attentively examined elsewhere, it will be found, as well as most of the other members of the New-York system, to be more generally diffused than at present supposed, or rather made known.

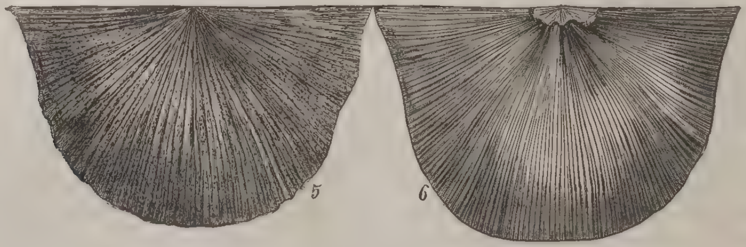
But a few only of its fossils are given for illustration. The Big-ribbed delthyris (No. 1 of the wood-cut) is in great number in the first district, and so also is the Thick-winged delthyris (D. pachyoptera), from whence the first name of the rock was in part derived. They both occur at the east end of the district, but soon disappear or run out, and both occur in the part where shale greatly predominates. They occur in Pennsylvania; and in the Chinese museum recently established in Philadelphia, there was a delthyris from China, which greatly resembled the pachyoptera.

No. 2. The Smooth atrypa is in great abundance, especially in Herkimer county; and it appears to be numerous at Oriskany falls, just under the Oriskany sandstone, which covers that part of the rock containing them. A specimen was seen showing that a slight sprinkling of sand existed in the limestone which covered the shells, being the beginning of a change, or apparition of a power, which, like the wand of the enchanter, put an end almost wholly to all the tenants of the argillaceous and calcareous masses of the Catskill rock in New-York, and ushered in another series, no less extraordinary than those whose existence was thus ended. The Smooth atrypa, throughout the range of the Oriskany sandstone, was seen only in a loose mass in Otsego county.

No. 3, belongs to another division of atrypa, which, like those of this genus already noticed, also merits attention. The valves of this division are very unequal; the upper one is flat, and forms with the end opposite to the beak, nearly a right angle; the lower valve curves from the beak to the straight line on the opposite side. The middle or mesial part is very much depressed. There are about four species of this division in the State, one of which only has been named by Mr. Conrad, namely, the peculiaris, and which belongs to the next rock in succession, the Oriskany sandstone. The species of the wood-cut is more remarkable; and to show their allied nature, the name of *Singular* is proposed (A. singularis). Size natural.

No. 4, is another species, which may be considered as the type or characteristic of the division, and thence may properly be termed the *Medial atrypa* (A. medialis), the others diverging or converging from this middle point. Size natural.

27.



No. 5. Punctulated strophomena (S. punctulifera). No. 6. Radiated strophomena (S. radiata).

There are two species of strophomena in this rock, which are very numerous, and by which the rock may in many of its localities be readily determined. They abound through its range in Herkimer county, associated with the Smooth atrypa, the Medial atrypa, and the Depressed strophomena, which latter reäppears in this rock from the Niagara group, not having been seen in the intermediate ones in the district. The internal impression of the two fossils in question are given, by reason of their greater abundance than the shells themselves, and especially as these latter will with certainty be figured in the Report on the Fossils of the State.

The following list presents all the fossils belonging to this rock, which have been identified and named by Mr. Conrad up to this time:

TESTACEA, OR SHELLS.

Delthyris macropleura.
Delthyris pachyoptera.
Delthyris granulosa.
Delthyris bilobata.
Orthis resembling the resupinata.
Strophomena punctulifera.
Strophomena rugosa (the depressa).
Strophomena radiata.
Strophomena indentata.
Atrypa resembling the concentrica of the Hamilton group.
Atrypa prisca.
Atrypa inflata.
Platyceras ventricosum.
Platyceras gebhardii.
Calceola plicata.
Conularia quadrisulcata.
Tentaculites scalaris.

CORALEA, OR CORALS.

Calamopora favosa.

CRUSTACEA.

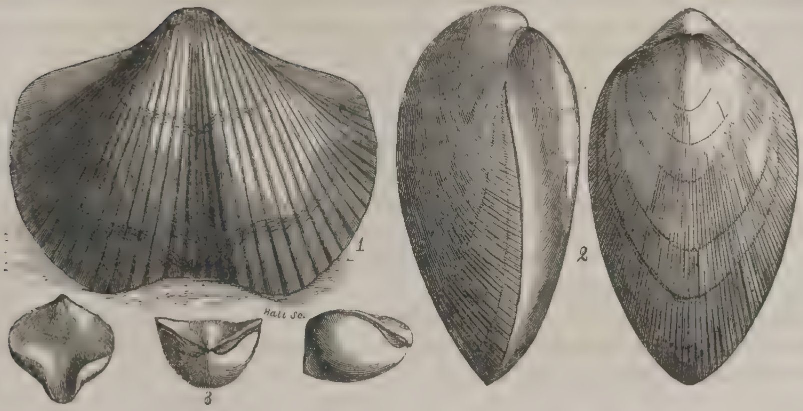
Asaphus pleuroptyx.
Asaphus nasutus.
Ascidopsis tuberculatus.
Acanthaloma, not determined.
Dicranurus, ditto.

## 16. ORISKANY SANDSTONE.

*White Sandstone of the Report of* 1838.

(No. 7 OF THE PENNSYLVANIA SURVEY.)

28.



No. 1. Arenaceous delthyris (D. arenaria). No. 2. Elongated atrypa (A. elongata). No. 3. Peculiar atrypa (A. peculiaris).

This sandstone holds a fixed position in the series, and is readily traced from east to west through the district, by its composition and its numerous characteristic fossils, not so much as to kinds as individual species. Its position is best seen in the first district near Salem; the Helderberg division, of which it forms a part, being complete. It projects from the side of the Helderberg mountain, forming a terrace resting upon the Catskill shaly limestone, in the upper part of which the encrinal pelvis is found; the sandstone passing under, or covered with the cauda-galli grit, the latter being a thick abrupt mass.

In the third district, its immediate associates cease entirely before reaching the west end of Madison county; and the sandstone from thence rests upon the Manlius water-lime group, and is covered by the Onondaga limestone, the three rocks being coässociates to Cayuga lake. It is very variable in thickness, owing probably to the unevenness of the surface upon which it was deposited.

With some exceptions, this sandstone consists of a medium sized quartz sand, such as is derived from primary rocks, either of granite, gneiss or mica schist. It is of a light yellow color when pure, as at Oriskany falls. At other localities the yellow color is often shaded brown, or of some other dark color. This sandstone and the calciferous sandrock, including the Potsdam sandstone, are the only two rocks of the district which present unaltered the sand of the primary region, as it appears where pure.

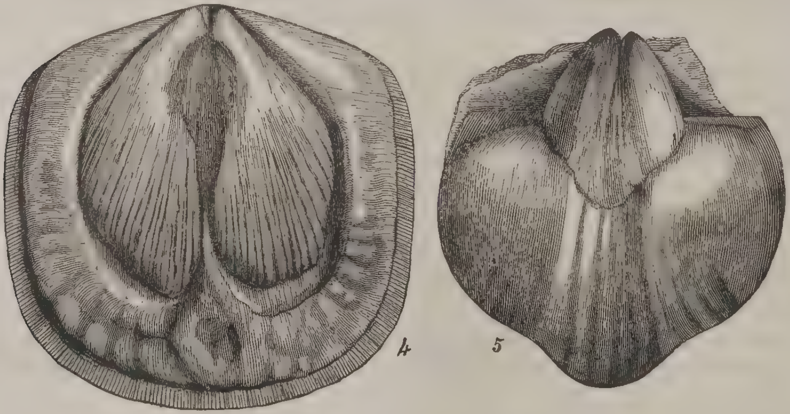
The localities of the sandstone are more numerous at the west end of the district, than at the east end.

The fossil shells in this sandstone are of an unusually large size, and in most localities crowded together, and near the lower part of the rock. The most common and characteristic ones in the district are Nos. 1 and 2 of the preceding wood-cut, and No. 4 of the succeeding one, which represents the internal form or cavity of the Atrypa unguiformis of Mr. Conrad. This truly remarkable impression in no small degree resembles the under part of the hoof of a colt, and is often taken for such.

This fossil cannot, consistently with what is known of the genus Atrypa, belong to it. It stands alone? but its association with two other casts in the same sandstone, and a fourth in the Onondaga limestone, shows it to belong to a genus between Strophomena, Orthis and Atrypa, uniting probably the three. A good name at present for the genus, will be *Hipparionix*, the right meaning of which is *Colt's nail*, but by which we mean *hoof;* it being a singular fact that neither the Greek or Latin language has any term for *hoof*, as in the Saxon; and when it shall be desirable to give precision of language to natural science, the three languages must be united.

There being but three species that we know belong to this genus, their names in the order of resemblance, will be *Proximate hipparionix* (H. proximus), *Consimilar hipparionix* (H. consimilis), and *Similar hipparionix* (H. similaris).

29.



No. 4. Cast of internal part of the Proximate hipparionix.

No. 5. Cast of the internal part of the Arenaceous delthyris. This latter cast is very abundant, and its peculiar appearance has given rise to many fanciful resemblances.

With due diligence, some trace of this sandstone might have been discovered at Cherry-Valley, where the Helderberg series is so complete.

The first place where this sandstone was seen at the east end of the district, was at Grout's quarry in the town of Springfield, on the road to Cooperstown. In removing the alluvial from the top of the Onondaga limestone which forms the rock of the quarry, a few large masses of the sandstone were thrown out, of about a foot in thickness. This is one of the innumerable instances, along the line of that whole section, of fragments of lower rocks being found above their own level, and to which attention will be drawn in the subsequent part of the report.

The fossils in this upraised mass, and which cannot be far from its natal place, consist of the Arenaceous delthyris, Elongated atrypa, and an atrypa yet unnamed. It has also some of the Smooth atrypa which belongs to the rock just under it, being the only part of the district where this fossil was seen in the sandstone ; the presence, probably, of a small admixture of limestone may have enabled it to resist a little longer the cause which put an end to the race further west.

The first place going west where the sandstone was seen *in situ*, was at the north of Horace Eastman's limestone quarry, on the road from Paris-hill to Waterville. It lies immediately under the Onondaga limestone. It is impure, yellowish and ferruginous, containing numerous accretions of globuliform black sandstone. These accretions commenced from a centre, for the color and cohesion diminish towards the circumference ; the cement appears to be a mixture of oxides of manganese and iron. It greatly resembles portions of this sandstone, as it exists in the Helderberg near the village of Salem.

At Oriskany falls, to the north of the village, the sandstone is exposed for some distance, forming a ledge or mass about twenty feet thick, divided into two and three layers. It is of a light yellow color, friable in some places, and readily crumbling into sand which is free from impurities. No part of it is sufficiently solid for durable work. Its place there is, however, well supplied by the thick body of limestone which lies below it, though none of its layers will compare in thickness with those of the sandstone.

Fossils, or rather their cavities, the shelly parts being generally removed, are very numerous in the lower part of the mass, but none whatever in the middle or upper part. The most common are the Arenaceous delthyris, Elongated atrypa, Unguiform atrypa, etc. There is also an avicula, which probably is different from the gebhardi.

This sandstone was used in the glass-houses at Vernon, when they were in operation.

The sandstone rests upon the same limestone as at the Helderberg. The Smooth atrypa (A. lævis), which is one of the common fossils of the Catskill shaly limestone, is numerous in parts near the surface of the limestone, as was remarked when treating of that rock.

The edge of the sandstone is exposed on the farm of Mr. Vannep, about three-quarters of a mile northeast of Perryville. It lies immediately below the Onondaga limestone, which forms a terrace extending to the village. The sandstone is of a dark grey color, blackish and red, some of it having the appearance of jasper, owing to red oxide of iron, of which an abundance appears to exist at the lower part of the mass, but too much mixed with sand, or the matter of the rock, to be as yet of use. From one to two hundred tons of ore were quarried for the Lenox furnace, but was not found to be workable, from the refractory nature of the sand; no simple earth being fusible in an ordinary furnace, but three are required to fuse readily.

This is the only locality which I know of in this rock, either in this State or further south, where iron ore exists, and no opinion favorable to the discovery of ore more free from its matrix could be given. There are many localities in New-York in the Clinton group, where sandstone is highly colored and coated with iron ore; but no appearance exists in those places, to exhibit itself in a separate state, owing doubtless to the easy permeation of the mass to the particles of the ore, and the difficulty if not impossibility of their ejecting such heavy particles as sand from the sphere of their aggregation, crystallizing carbonate of lime having no power of the kind, though highly active when in that state, and the red oxide of iron on the contrary is rather a passive substance.

At the Falls at Perryville, and below Cazenovia, the Oriskany sandstone is but a few inches in thickness.

The sandstone appears in the side hill about a mile and a half south of Onondaga hollow, on the west side. It is but partially exposed, showing a thickness of about seven feet. It contains some of the usual fossils; also a fucoid of a peculiar kind, not heretofore seen in this, or in any other rock: it is in the State Collection.

At Split-rock, very little of this sandstone is to be seen; it shows itself between the water-lime group and the Onondaga limestone, from a mere sprinkling of sand, to a thickness of about sixi nches.

Between Elbridge and Skaneateles, on the old Seneca road, the sandstone shows itself in the road, and of a thickness of about thirty feet. Towards the middle parts there are a few straight fucoids about one-third of an inch in diameter, and others about the size of a pipe stem, the whole of which are in a vertical position: no branches observed. The sandstone is white, yellowish and dark grey, with spots or points of hydrate of iron, as if from decomposed pyrites.

On a parallel road to the outlet of Skaneateles, is the quarry from whence the stone for the lock at Jordan was obtained. Not much rock is exposed; the lowest layer was the one used. Fossils few in number, chiefly the Arenaceous delthyris; there was also a pileopsis and a columnaria, such fossils being rare in this sandstone in the third district. The stone in the lock at Jordan has resisted the wear and the weather, better than would be supposed for a rock of its loose texture or nature.

To the right of the road on the farm of E. Grizzle, in sinking a well, this rock showed a thickness of twenty-two feet, under which was the dark colored limestone of the water-lime group, the same layer from whence the blocks to the north of the village of Skaneateles were derived.

The Oriskany sandstone appears in the quarries to the north of Auburn, between the water-lime group and Onondaga limestone. It is quite thin, varying from a few inches to two and a half feet in thickness. Fossils are quite numerous in the New-York quarry near the Prison, consisting of all the usual ones of this rock. The sandstone not being pure, the specimens do not appear to the same advantage as at the next point where it was examined.

The last locality, to the west, where the sandstone was seen, is to the right of the road between Auburn and Springport, on the land of Mr. Yawger. It is in a wood, forming a low ledge which is exposed for some distance. Its thickness is nearly three feet: it has been quarried. The fossils are numerous, and better preserved than in any other locality of the district, State or country, that has come to our knowledge; the rock being more solid, and the sand of which it is composed, purer, and white. Most of the fine specimens in the collection of the State, are from this locality.

A few broken up layers of the Onondaga limestone rest upon the sandstone, the outcrop at the quarry being merely exposed. They form a part of the terminal portions of the terrace, which sweeps round from Auburn toward Springport.

Boulders or blocks of this sandstone are very common to the south of its range in Madison county, being found upon the tops of the hills, and upon the hill-sides in the towns of Madison, Eaton, Hamilton, Lebanon, &c., for about fourteen or more miles from its northern outcrop at Oriskany falls. In smaller masses it has been found from forty to fifty miles south of that line.

The great facility with which this rock is recognized; its character so peculiar, contrasting so strongly with all the rocks of New-York; its layers so thick at Oriskany falls, make it a useful rock in investigating the history of the ancient flows of water in that section of country.

This rock is but a thin mass in New-York, when compared with Pennsylvania, where, according to Prof. Rodgers, its maximum thickness is seven hundred feet. Its localities in that State are numerous, and it is an important rock, as might be supposed, when it forms one of the nine numbers or formations into which all the rocks of that State, which correspond with the New-York system, are divided; having been arranged by its geologists under the name of the *Appalachian system*, the two systems differing only in name.

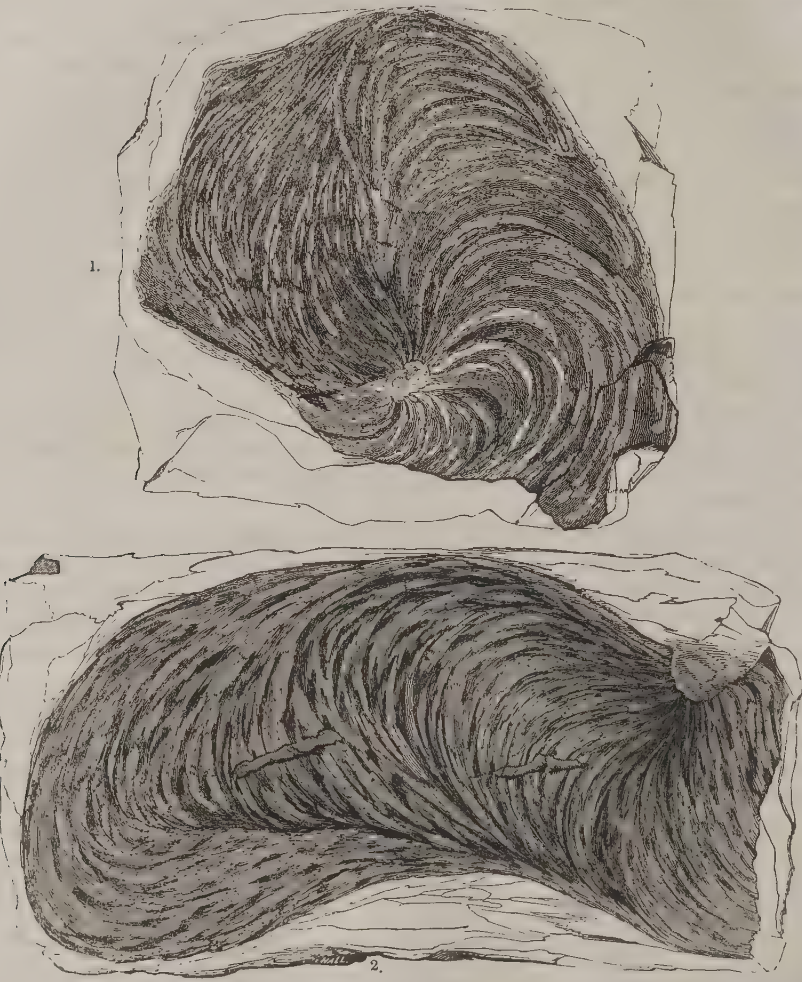
In the collection of Prof. Hitchcock at Amherst, there are specimens of this sandstone from Greifenstein in Nasovia; and no doubt, before many years, the whole of the New-York divisions will be recognized as existing in other and distant countries, having now the facts necessary for recognition.

## 17. CAUDA-GALLI GRIT.

*Cocktail Grit, of* Dr. James Eights.

This rock is altogether peculiar, receiving its name from its mineral character, and from the feathery forms or appearances which abound in it. It is a fine grained, calcareous and argillaceous sandstone, usually drab and brownish, and by long weathering it blanches. It readily strikes the eye by its contrast with its associated rocks, and by the singular markings or impressions which it contains, some of which, and parts of all, strongly resemble the curling feathers of the tail of the male of our common barnyard fowl, or *rooster*.

30.



No. 1 of the wood-cut is the common form which belongs to this rock ; the curves pass or rise from a common centre, which is raised or depressed according as the upper or lower impression is examined. The curves usually have this peculiarity, that though their direction is continuous, they are broken or uninterrupted. The size of the forms vary from about four inches to a foot or more in diameter. They are more or less circular, and have no well defined outline, in which they differ from the next in kind.

No. 2, has a well defined outline, which characterizes all that were found in the two higher positions, being found in three distinct ones in the New-York system, as it exists in the State. No. 2 is rare in the grit, but common in the higher rocks; this being the only specimen remembered to have been seen with a well defined outline. The force which moved the rays or particles which gave rise to this form, was excentric, returning upon itself in parallels, like the movement of a comet. In the upper rock, appearances still more singular are met with.

The material of which these forms are composed is as yet unknown, being too minute to be detected by ordinary means. Some of the specimens from the upper rock are of a black color, which evidently was the result of a subsequent deposit, as in the coating of the cypricardites in the sandstone quarry to the south of Rome. This fact is of importance in this respect, that it shows that there was space for a deposit, or coating between the surfaces.

The feathery forms are usually numerous in all its localities in the district: they are generally arranged in parallels; and from their broad surface and little adhesion, the rock readily breaks in the direction in which they are placed, thereby giving to it an irregular fissile character.

This rock is first seen at the east of the district, to the north of Cherry-Valley village; being a thick mass in the first district, from whence it passes west. It appears on the road to Fort-Plain; the road to Judd's furnace; and along the brook between the two roads. The best specimens of these three localities are to be obtained at the latter one. At all these localities it is of a light drab color, its fracture fine granular and dull. It is slightly calcareous, and by the action of heat, a red appearance is produced; no other change takes place, and it makes a good fire stone. It rests upon the Catskill shaly limestone apparently, but the line of juncture is not evident, the Oriskany sandstone not having been seen at that locality, as its position is concealed by soil, etc.

It is again met with in place on the road from Cherry-Valley to Springfield, near to where the road to Cooperstown from Fort-Plain crosses it. It forms a rise or small elevation on the south side of the road. It is quarried for the adjoining enclosures: its color is drab and brownish, the latter more altered. Some of the former color contains green grains, resembling those in the upper part of the fucoidal layers at Canajoharie.

The rock again appears in the road from Fort-Plain to Richford springs, in the town of Warren, Herkimer county. Beyond this county to the west, it was not seen in place, and must come to an end near the east line of Oneida county. Numerous fragments of the grit are met with in many parts of its range in Otsego and Herkimer counties, along the line of its outcrop, and for some miles south of it. It appears to wear away, but not to decompose.

This grit exists in New Jersey near the Delaware in Sussex county, but has not been noticed elsewhere. In that State the same impressions exist, and equally abundant. They are described by its Geologist, "as a circular disc, often a foot in diameter, of radiating arched

" fibres, curving outwards from the centre, always in the same direction, like the hair part-" ing on the crown of a man's head." This description accords perfectly well with No. 1 of the woodcut.

The origin of these singular forms, at one period of the survey, did not appear easy to determine. From the great abundance of unknown forms of marine vegetation which exist in many of the rocks of the New-York system, the obvious and primary conclusion was that they were sea plants, and to be referred to fucoids; no fact then being known, which could lead to the adoption of a contrary or different conclusion. Had not their organic nature been as it were determined, I should at one time have been disposed to have advocated the opposite one, namely, mineral; having had my attention attracted by the perfect resemblance which water, when freezing upon a board, presents to these forms; and also in a shallow pond, when the temperature is of that degree merely, which produces an extremely thin sheet of ice. In the former instance, there was identity with the forms of this mass; being unprovided with stems, and the parts being interrupted, and more raised or in relief, and without a defined outline. In the latter case, there were well defined stems, a foot or more in length at the one end, and at the other the continuous feathery or plumose appearance, curving circularly, and resembling some which have been seen in the rocks of the Hamilton group, one of which is figured under the head of that group. From these facts, it was conceivable that the forms in question might be owing to the crystallization of some material, which belonged or existed in the rock, having like properties as to form with water, and exhibiting them when the condition for their production existed or were complied with. The contrary opinion must, however, be the true one, when we consider their great number, their fixed position, the many peculiar forms which those of the upper rocks present, and our total ignorance of the existence of any substance other than water which could produce them; and were this the cause, they would not, as one might suppose from its universality, be restricted as they are to the three positions in which they are found. And finally, that no difficulty exists in adhering to the opinion first advanced of their vegetable nature; firmly believing that the power which gives form to crystals is as much an agent in the production of form in organic bodies as it is in inorganic ones, the difference between the two being caused by the addition of life as in vegetables, and of life and consciousness as in animals, or their causes, should such an expression be preferred; these powers modifying the action of the primary one, just as we find that the laws of chemical action are changed by the same causes or powers, producing thereby a mineral, vegetable, and animal chemistry.

Be the cause of these forms what it may, it is not extraordinary that near the confines of the two regions of organic and inorganic bodies, appearances should exist, in which a difficulty might occur as to which they should be referred. The subject is of interest from their form, the graceful curves which they exhibit, their fixed position, and their great number; leading the mind also to connect powers which should be brought together from their universality and kindred nature, but judging from the manner in which they are considered, would, but for facts of this kind, be probably ever kept asunder.

## 18. SCHOHARIE GRIT.

### *Shell Grit.*

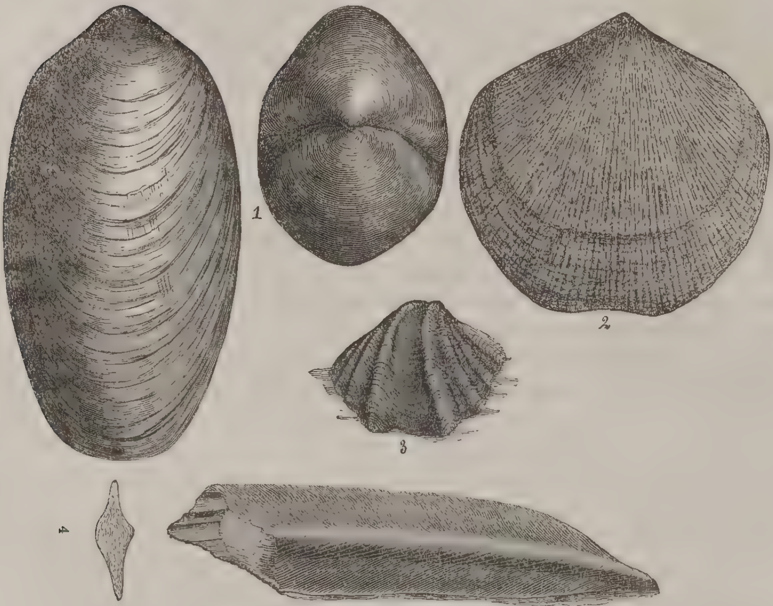
This mass, which exists in the first district, must disappear near Cherry-Valley, a few loose pieces only having been found to the northeast of the village. It is not confined to this State, but is also found in Pendleton, Madison county, Indiana, where it is readily recognized by its peculiar mineral character, the rock being a calcareous fine-grained sandstone, from which, when long exposed, the carbonate of lime disappears without altering the form of the rock; and by its fossils, the genus Pleurorhynchus, for example, being as abundant in it as in the New-York grit.

As this rock is highly fossiliferous, and most of the fossils are peculiar and confined to it, though their existence was at first but merely suspected, it could not be passed unnoticed.

## 19. ONONDAGA LIMESTONE.

*Grey Sparry Limestone of the Reports.*

31.



No. 1. Elongated pentamerus (P. elongata). Two views.
2. Consimilar hipparionix (H. consimilaris).
No. 3. Undulated delthyris (D. undulatus).
4. Defensive fin bone of a fish (Ichthyodorulite).

This limestone extends from the Helderberg to near Lake Erie. Its line of continuity is unbroken in the third district, excepting by valleys or water courses. Though so persistent as to direction and continuity, it rarely exceeds ten or fourteen feet in thickness. It is readily recognized by its light grey color, crystalline structure, toughness, and its organic remains, which are very numerous. It abounds in smooth encrinal stems, which for the present may be termed *Encrinites lævis*, the largest species in the district, and is found only in this rock in the State. Some of the stems are about an inch in diameter, and usually they are over half an inch. In almost all its localities it is replaced by lamellar carbonate of lime. Some of the specimens are in parts of a pink color, favorably contrasting with other parts which are usually of a milk white color, and with the green shale of the rock to which its layers and courses are owing.

There are many fossils by which this rock is readily recognized, and are characteristic of it, besides the Encrinites lævis. Among them is the Elongated pentamerus (No. 1 of the wood-cut). This fossil is generally diffused in this rock, and so far as our knowledge of it extends, is confined to it. Some of the specimens show a considerable size, being about 2½ inches in depth or thickness, and 4⅞ inches in length. The Undulated delthyris, which resembles the Thick-ribbed delthyris, is also found in it; but the ribs are not so round, and the surface is covered with undulations in the direction of the lines of growth, whence its name. It contains also the Consimilar hipparionix (No. 3 of the wood-cut), which is also found in several localities. It is the only rock in which the Gigantic cyathophyllum (C. gigantea) is found; one of which, in the State Collection, is over eight inches in length and two and a half in diameter. There are four other species of this genus in the collection from this rock; about three species of the Platyceras, three of the Platyostoma, and several other fossils which are new, among which is the fish-bone (No. 4 of the wood-cut). This is the first rock in the district, in which any thing of the kind had been seen or heard of. In the State Collection there is another one from the fourth district, but very imperfectly preserved, found by Mr. Hall in the Oriskany sandstone, the lowest position in which any remains in the State have been discovered of an animal higher in the scale of organization than Crustacea, or the class to which crabs, lobsters, etc. belong. There are fish bones of like character in the State Collection, obtained from the next rock in succession in both districts; all which seem to have served a common purpose, appearing to be the major spine of the back or dorsal fin.

The layers and courses of this limestone, as usual with limestone rocks, are separated by shale, which is of a greenish color, but in small amount. It is coëxtensive with the rock, a fact of some importance in the theory or cause of the color of rocks; for the less the crystalline action, the more the red, black and yellow colors predominate, crystallization favoring a lower degree of oxidation of the metallic coloring matter.

The Onondaga limestone, though generally nearly pure, in some localities contains numerous nodules of flint, and in parallel layers. Its vertical joints are very regular in two directions, at nearly right angles to each other, often dividing the layers into convenient sized masses: direction of the joints, N. 33° to 35° E., and S. 55° to 57° E.

It is one of the most valuable building stones in the Helderberg division. It is largely quarried near Syracuse for the canal, and is more or less used as a marble throughout the district. Its power to resist the action of air, water and frost, is shown from the fact of its being the bottom rock of streams which no longer exist; and it is the rock generally over which the water flows north, forming the falls great and small at the west end of its range, the most noted of which are those of Perryville and Cazenovia.

This limestone forms a conspicuous ledge of about twelve feet thick to the right of the road from Fort-Plain to Cherry-Valley, the surface of the rock being uncovered for some extent. It continues to the village, but is concealed in part of its course by alluvion thrown up into low hills. It forms the surface of the valley, and is uncovered in many parts above the road which crosses the valley towards the lower part of the village. The north projecting end which faces the Mohawk valley, shows that for a long time it was the bottom of a river or flow of water; and the vertical joints being greatly enlarged, exhibit separations, a few of which are two and three feet wide; the surface presenting in one place a series of insulated gigantic blocks, arranged in regular order, and in conformity to the direction of their joints, evidently the result of solution and wear by water, and presenting in all respects the same phenomenon observable on Cincinnati creek and Sugar river from the points where their waters respectively disappear.

A notice of the discovery and importance of this limestone as a marble was published many years ago in the Cherry-Valley Gazette, and it was described as being like the Potomac marble used at Washington. The fossils probably were taken for pebbles, and the green coating between the courses, and which gives a greenish color to portions of it, completed the supposed identity. The Potomac marble belongs to the New red-sandstone, whose origin was subsequent to the Coal; the latter mass being placed between the New red-sandstone, and the Catskill group.

The Onondaga limestone takes a good polish, and is used at the village as a marble, and as a building stone. It is quarried at the bottom of the valley near the village. The stone there has a fresher or less altered surface than at its north end, where it is much weathered and discolored. When fresh quarried, it is of a light grey, its grain small and coarse; the latter is easiest to work, the former being tough: some parts have a pink hue.

A level was made from the surface of this valley, which commences on the top part of the Onondaga limestone, to the Mohawk river, and found to be twelve hundred feet. This height will give some idea of the change which has taken place in that valley since the waters flowed over the Onondaga limestone, which forms the bottom of the valley. The north outcrop of the limestone, which appears at the edge of the great valley, shows a flow of water north, just as exists now in every valley west of Sauquoit creek inclusive. The surface towards the village of Cherry-Valley, and the excavation of the valley, show, on the contrary, a flow of water south; and the latter is fully confirmed by the enormous quantity of northern drift in the form of pebbles, boulders, etc. which extend along the valley throughout its whole course. Like all the other rocks, the Onondaga limestone dips to the south, which is well observed at Cherry-Valley. It is probable that the dip increases at no great distance from where it disappears, which would more readily account for higher rocks in the series presenting themselves at the levels where they appear; a circumstance noticed in other valleys further west, Bridgewater valley for example, though it may be admitted that the fact is but in appearance only.

Fossils are quite numerous at this locality: most of those before enumerated were found, the Elongated pentamerus being abundant, but not well preserved.

The Onondaga limestone is quarried as a marble on the road to Cooperstown in the town of Springfield, by Mr. Grout. There are but few layers opened; the stone is of good quality, and is handsome when polished. The large encrinal stems are numerous, and often partially of a pink color.

In Herkimer county, it is quarried but in one place, on the farm of Nicholas Smith in the town of Stark. It is seen through the towns of Warren and Columbia, but not much is exposed, owing to the abundance of alluvion which has been thrown up into ridges through those towns. It forms rather an extensive terrace to the south of Cedarville, inclining as usual to the southwest. To the south of Gilman's tavern, this rock contains flint in abundance; but it is readily distiguished from the true corniferous limestone above it, by its fossils, its crystalline grain, its lighter color, and by the slight coating of green shale spread over the surface of its layers.

It is exposed for some distance along the base of the hill, and at its north extremity, which forms the east side of Bridgewater valley, below Green's quarry. It abounds with nodules of flint, and appears to be of greater thickness than is usual with this rock.

South of Paris hill, on Mr. Eastman's farm, it was quarried for field enclosures; it is there remarkably abundant in nodules of flint, which makes it unsuitable for any other than rough work of that kind. The color of the limestone is unusually white. It forms the terrace which covers the Oriskany sandstone, which appears at the edge, and is itself covered by the corniferous limestone, which is quarried near the house.

It is not quarried in any place noticed between Eastman's and Perryville, but may be seen descending the ridge to Munsville, and also at Oneida falls; and it is readily found by its lighter color, resting upon the Oriskany sandstone, or in its absence upon the blue or brownish compact layers of the water-lime group, in every direction west of Oneida creek in the line of its outcrop. Its presence may always be suspected in ascending the range south of the gypseous hills, wherever a level surface or terrace of any extent exists.

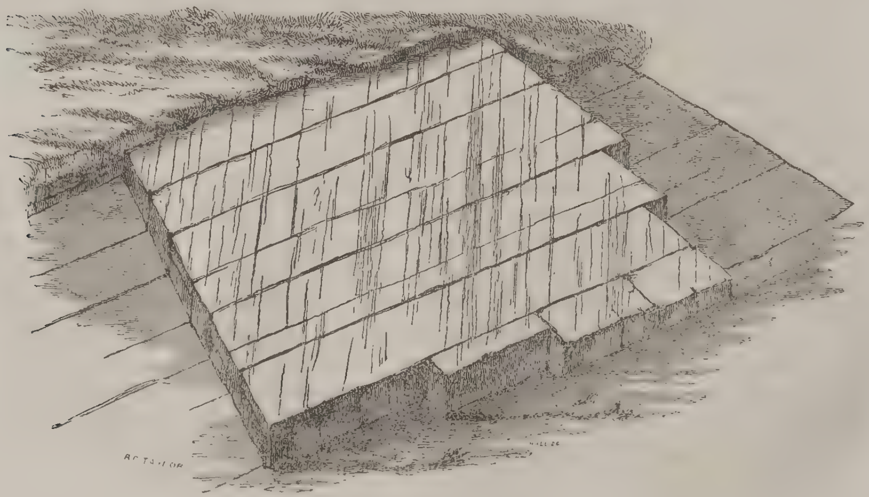
At Vannep's near Perryville, the top of this limestone, which there forms a broad and extensive terrace, abounds, near the excavation for iron ore, in long parallel fissures in two directions, like those of Sugar river, the result of a like cause. The mass is about ten feet thick. The layer next to the bottom one contains nodules of flint, as at the falls of Perryville. The Cyathophyllum vermiculare, here as in most other localities, appears at the lower part of the bottom layer. The rock appears to be nearly level; but between there and Perryville, the inclination southwest is quite considerable for this rock. At Perryville, the waters of Canaseraga creek fall from this rock into a gulf of about one hundred and twenty feet deep, excavated in the water-lime group. So also to the north of Cazenovia, those of Chittenango creek precipitate over the same ledge into a like gulf, the limestone continuing upon the high bank on the west side of the creek, with an increase of breadth advancing towards the village of Chittenango, back of which it is quarried upon a small scale, but more largely on the east side of the creek near the falls. Where the ledge or terrace turns to the west from the creek, south of the village of Chittenango, it appears as a high cliff, but partially concealed by the thick woods in front. In all these localities the rock is of good quality, either for building or burning; but for the latter purpose, the compact dark blue oblique cracked limestone of the group below is preferred, as being more easy to break, and requiring less heat to obtain the same measure of lime, which is sold by measure and not by weight.

The beautiful specimen of coral in the State Collection, arranged in the Table containing the fossils of the Onondaga limestone, is from the quarry to the south of Chittenango village. It consists of circular stars of uniform size, about three-fourths of an inch in diameter, composed of rays slightly undulating and curved, round and crenulated, which pass from one to another by straight and angular lines; no distinct division existing between the stars, other than a slight enlargement of the crenulations and angles of the rays. In the centre of each star or circle, there is a small raised disk, as in Astrea; the disk being composed of rays, which bifurcate at the outer margin. It does not appear to belong to any known genus, but is allied to Astrea and Acervularia, making a third one with them. Considering it distinct, the name of *Asterocycles* is proposed for the genus, and *confluens* for the species; it will therefore be, in anglicized language, *Confluent asterocycles.* No less than three distinct circles are to be perceived within the outer one, and formed by the undulations of the rays.

Near Manlius square, in a west and south direction, the Onondaga limestone is seen upon the water-lime group at the kilns, having a few inches of Oriskany sandstone between them. It is covered by the corniferous limestone, and not much of it is exposed. It contains the Gigantic cyathophyllum, as well as the Elongated pentamerus so characterstic of this rock.

At Split-rock, to the southwest of Syracuse, the surface of the rock is uncovered for a mile or more from east to west, and farmed out to contractors, furnishing stone for a considerable portion of the western section of the canal. The rock has a slight dip to the south and west, and from one or more fractures which it exhibits, it obtained the name of *Split rock.* West of these fractures, there are sink-holes; and the waters which formed them, probably removed a part of the support of the rock, and produced the fractures, the rock inclining from them towards the east. At one of the holes, the layers are much disturbed.

32.



The above wood-cut, from a drawing by R. C. Taylor, exhibits a portion of a layer of Onondaga limestone at Split-rock quarry, showing the well defined vertical joints in two directions at nearly right angles to each other, so characteristic of this rock, as well as of most of the rocks of New-York belonging to its system: one of the joints is E.N.E. The surface of the rock, as in the wood-cut, shows slight scratches, the direction of which is north and south. The lower layers of the limestone frequently contain black pebbles, whose water-worn character admits of no doubt. When fractured, they show identity with the sandstone nodules or accretions which are found in the Oriskany sandstone south of Paris hill, near Eastman's quarry.

At the village of Marcellus, it forms the bottom of the creek at the mill. It appears to be of a darker grey, finer grained, and less encrinal than usual; but little, however, is exposed.

The last place of note, where the Onondaga limestone is much exposed and quarried, is to the north of Auburn, in front of the village, and east of the outlet. It is said that when the building of the Prison was commenced, the stone used for the foundation was brought from a distance; the architects not being aware that the water-lime group, the rock of Split-rock, and the corniferous limestone, underlaid that section, and that their outcrop was but a short distance from the site of the building, extending east and west. The Onondaga limestone is the rock which is wrought at the Prison, and of which so many of the buildings of Auburn are constructed; being sold at so low a rate, that preference in all cases even where expense is considered, is given to it. It rests there upon the Oriskany sandstone, which is of variable thickness, and is covered by the corniferous limestone. The same black rolled stones, consisting of accretions from the Oriskany sandstone, occur in the bottom layer. Fossils are not numerous, those found being some of the kinds already enumerated.

Beyond Auburn, though the terrace of which it generally forms the surface rock is well defined, yet from alluvion and soil the rock is but little exposed. Among other points where it was seen, and which are of importance from the presence of other masses, is Yawger's quarry, above the Oriskany sandstone, near the road to Springport; and upon the top of Blanding quarry at Springport, between Howland's quarry and the lake, being its last appearance in the district.

The Onondaga limestone has not yet been noticed as existing out of the State, but it is no doubt a regular associate of the Helderberg divison, wherever this division exists, being what was once termed an universal formation or mass. The Smooth encrinite exists in prodigious abundance about ten miles north of Nashville, where I collected it with Prof. Troost, the Geologist of Tennessee, fifteen years ago. Recently I saw a specimen of it in the possession of Mr. Conrad, given to him by Mr. Lyell, and imbedded in the same peculiar limestone as the Onondaga. It was from the Wenlock limestone of Mr. Murchison in England, and showed perfect identity with that of New-York. At the locality near Nashville there was no quarry, the encrinites were replaced with silex, and we had no opportunity of obtaining an unaltered specimen of the rock which had enclosed them.

*List of Fossils from the Reports, etc. of* T. A. Conrad, *which are found in the Onondaga limestone, and identified and named by him to this period.*

### Testacea, or Shells.

Delthyris raricosta.
Strophomena gibbosa.
— perplana.
Atrypa nasuta.
— unisulcata.
— acutiplicata.

Avicula pecteniformis.
Cypricardites inflata.
Bellerophon curvilineatus.
Pleurotomaria poulsoni.
— unisulcata.

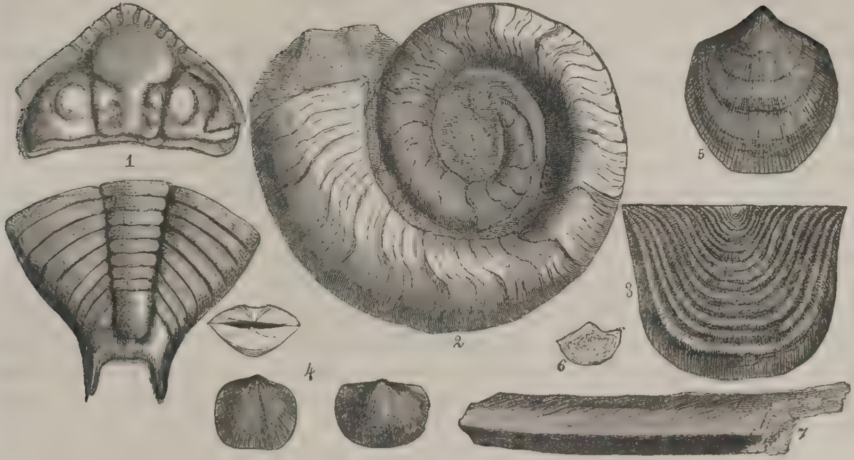
### Crustacea.

Asaphus aspectans.

It is possible that D. raricosta may be the same with D. undulatus of the wood-cut; but the latter is not rare as to number of ribs, having not only the same with D. macropleura and D. pachyoptera, but with an undescribed Delthyris found by Dr. Budd of Lewis county, in the Trenton limestone of that county, and having characters somewhat intermediate to macropleura and undulatus.

## 20. CORNIFEROUS LIMESTONE.

33.



No. 1. Head and tail of the Moon-tail odontocephalus (O. selenurus).
2. Undulated cyrtoceras (C. undulatus), reduced one-third in size.
3. Undulated strophomena (S. undulatus).
No. 4. Lenticular orthis (O. lenticularis).
5. Priscan atrypa (A. prisca).
6. Linear strophomena (S. lineata), magnified twice the natural size.
7. Fish-bone (Ichthyodorulite).

Under this head, the Seneca limestone of the Reports is also included; the two masses, however, are separately considered, and in the order of their succession, merely from the presence and great abundance of a single fossil species in the upper one. These limestones are the terminal members upwards of the Helderberg division of the New-York system. Above and resting upon this division, the thick masses of shale and sandstone commence, which extend south into Pennsylvania, and pass under the coal of that State, being the support of that deposit, and the termination upwards of the New-York system of rocks. Above the Helderberg division, there are no more masses of limestone in the district, or the State, that extend through the district, but partial masses only, the most extensive of which is the Tully limestone, which makes its appearance only at the west end of Chenango county, and continues through Onondaga and Cayuga counties into the fourth district.

*Corniferous limestone* is one of the names given by the late Prof. Eaton, in the survey of the Erie canal. It is retained, as being applicable to this rock; for it contains flint or hornstone in nodules, in one or two layers, throughout the whole extent of its range. The nodules are arranged in parallel layers, from two to ten in number. It is a character not to be relied upon alone; for all the limestone rocks, from that which forms the bed of the Niagara falls, to the one under consideration, contain flints in one or more localities, and arranged in the same manner. No difficulty now can take place in its use, the position of this limestone, including the Seneca, being well defined; resting invariably upon the Onondaga limestone, and covered by the Marcellus shales, the shales and the corniferous and Onondaga limestones being coëxtensive deposits in the district and State.

But little if any of the layers afford a pure limestone, being usually impure, the lower layers especially. Its color varies from black to ash grey, brownish, and light dull blue. The layers which contain flint are usually very compact; others show a crystalline grain, but more rarely; and there are many in which the mixture of shale is very evident, and even in great excess. The color of the rock is more dark at the west than at the east end of the district.

The joints or vertical divisions in this rock are extremely well defined; so that in quarrying, it presents walls or sides of the greatest regularity. Quarries are usually opened where the nodules of flint exist, the layers immediately below the flint being esteemed the best. The joints are nearly at right angles to each other; the one which is commonly observed in this rock, forming the back of the quarry, is north about twenty degrees east.

There are many fossils which are peculiar to the corniferous limestone, and by them it is readily recognized in the district; but the individuals are few, and are not found in every locality, and therefore are not so useful practically as many which are not exclusive, and which are numerous in the rock. They are, however, so different as a group from those of all its contiguous members, that it is readily known by them.

The most characteristic fossil of this rock is the Odontocephalus selenurus, figured as No. 1 of the preceding wood-cut. It is quite numerous in some parts of the limestone, but the heads and tails are separated. Only recently a specimen was found entire; previous to which they were supposed to belong to distinct trilobites, and known by distinct names; the head being the Calymene odontocephalus (*Tooth-head calymene*), and the tail part the Asaphus selenurus (*Moon-tailed asaphus*). They were united, and the genus and species constructed by Mr. Conrad from their conjoined specific names.

The next characteristic fossil is the Cyrtoceras trivolvis of Mr. Conrad. There are four or five species of this peculiar genus in this rock, all which look like ram's horns; they are from about four to seven inches in diameter. No. 2, the species figured in the wood-cut, is different, being more expanded towards the mouth, and the surface markings undulating upon the sides and back, whence its name of *undulatus*.

The corniferous limestone also contains two species of strophomena, which were formerly considered to be the same, and known by the name *S. depressa* or *rugosa*. No. 3 is the *Undulated strophomena*, and differs chiefly from the other in having about eighteen ridges upon the upper valve, while the rugosa or depressa has but about eight: the size of the shells is about the same. So far, the Undulated strophomena has only been seen in this rock.

No. 4 of the wood-cut is a small orthis, called *Lenticular orthis* (O. lenticularis), about half an inch in diameter; the striæ neither fine nor coarse, but sharp-edged, increasing laterally fourfold from the apex: three views; size natural. There is another, and a handsome orthis in this rock, which resembles a delthyris (O. delthyroidea).

No. 5. Atrypa prisca: It resembles the A. affinis, but the imbrications upon the surface are not so numerous, nor are the edges turned up as in the surface of that species.

The *Pectenform avicula* (A. pecteniformis) belongs to this rock, but it is not a common fossil: there is a specimen in the State collection.

No. 6. *Linear strophomena* (S. lineata). This is the small fossil so abundant in the upper part of this rock, which has heretofore been known by the name of Seneca limestone.

The fish-bone, No. 7 of the wood-cut, is a fragment found at the falls of Perryville. Its form resembles the one noticed in the subsequent pages of this work, as having been found in Seneca county. It is figured, because of the great interest which should attach to every apparition of the kind in this earth, which is our inheritance, and which we ought to comprehend aright, but can not without a knowledge of all its facts.

The corniferous limestone is at its maximum thickness in the village of Cherry-Valley, where it is probably from sixty to eighty feet thick. It rests upon the Onondaga limestone, showing two or three distinct terraces, which extend through the village, their edges ranging with the valley, and their surfaces sloping with it to the south.

Back of the Lancaster school-house, the rock is uncovered for many acres, showing to great advantage its fine regular slope or dip, and its water-worn surface; its joints being open from wear and solution, like those of the Onondaga at the head of the valley; exhibiting ample proof of the sojourn of water at that height, for a considerable period. Its terraces, ranging with the valley, show a gradual or rather a periodical narrowing of the valley from that point to the Onondaga at the bottom; the surface of which, being now dry, shows the total drainage of the valley. The layers containing flint are below the upper exposed surface; they may be seen in the quarry back of the house, formerly occupied by Judge Beardsley. The quarry shows the regular wall-like appearance common to this rock where the flint exists, the joints of the rock being straight and smooth.

To the north of the village, the rock is also quarried, the layers being thinner, and suitable for flagging.

The directions of the vertical joints were taken at several points, showing N. 20° to 22½° E. for one sett, and south of east for the other, the precise degree not noted, but to the eye were considered to be nearly at a right angle.

Along the road to Springfield, and to the south of Grout's quarry on the Cooperstown road, the rock occurs with the same well defined joints, the upper with flint. At Grout's the directions of the joints were N. 22½° E., and S. 57½° E. The surface of the limestone containing flint, is well exposed along the side-hill by quarrying; often showing ramose forms, highly imitative of those of vegetable life.

Through Warren, Columbia and Litchfield, in Herkimer county, quarries and small excavations appear, and with the same characters.

In Oneida county, it is quarried on the east side of Bridgewater valley, the ridge rising above the valley and forming its side. The corniferous forms the upper rock at Green's quarry, where the rock is exposed for some distance, although the excavations are but superficial, the demand for stone being inconsiderable.

Near Cassville is Town's quarry, from which considerable stone has been taken out. The upper part shows the nodules of flint; under which, for about twelve or fourteen feet, are the layers which are used. The joints are very straight, and the back of the quarry like a regular wall of the best ordered masonry: the direction of the joints the same as in the other quarries. This is a good locality for the *Trivolve cyrtoceras*, as it may be called, which is found as well in the hornstone as in the lower layers. It is, as before said, one of its most characteristic fossils, and the individuals appear to be numerous throughout Oneida county, but more rare to the east and west of that county.

South of Paris hill, and near the road to Waterville, is Eastman's quarry, the stone of which, as well as that of Cassville, is taken to Utica. There are but a few feet of this quarry opened, but it extends through a long line, and the layers are very straight, and remarkably favorable for levelling. This was done by a school teacher of the neighborhood, his name unknown, who found it to dip one inch to the rod, or about twenty-seven feet to the mile: its dip, as usual, to the southwest. The upper portion of the quarry consists of the nodules of flint, of which there are two layers, and the whole thickness exposed is about eight feet. The quarry is opened along its north-northeast joint, which is very straight, the other being nearly at a right angle. The Trivolve cyrtoceras is very common in one of the lower layers, and may be seen in many of the flag stones in the streets of Utica.

The whole of this rock appears to have been swept from off the ridge between Oriskany and Skanandoa creeks, as none is now to be seen thereon. It exists between the latter creek and Oneida creek; but is covered to a considerable extent by upper rocks and soil. It forms one of the rocks at Oneida falls, but is not quarried, nor in any part of its range through Madison county that was observed, the stone of the Onondaga and water-lime group being preferred. It nevertheless was deposited, for it was found in every point where sought; and so also through Onondaga and Cayuga counties. It is well exposed at West hill, to the south of Syracuse. About thirty or more feet of the rock is exposed at the side facing the north, but no quarry is opened. It shows several layers of flint; this mineral being very constant as an associate, but varying as to quantity in different parts of its range, depending as it must upon the quantity of siliceous particles disposed to come together, and the conditions favoring separation being complied with.

The hill-side to the east of Marcellus village shows also a like thickness of this rock, and with like characters; but none of it is quarried in Onondaga county. In Cayuga county it is otherwise, extensive quarries being opened in this rock at Auburn and Springport. At the former place, the quarries commence at the outlet, to the north of the village, and extend for some distance east. The two quarries nearest to the outlet are owned by a New-York company; the next is Buhr's; then McMasters and Sears'. At all these quarries, the part containing flint forms the capping stone of the quarries; the layers or ranges of flint are quite numerous, being from eight to ten in number; and the color of the solid part is deep blue, or rather black.

The quarry at the outlet shows from eight to nine layers of rock, the thickest three feet, the thinnest five inches; joints in two directions, at nearly right angles to each other. The upper layer bends downwards, passing under the outlet, and forming its bed; occasioned, no doubt, by the removal of that part of its foundation.

At the upper quarry the same layers appear, with those also of the lower part of the mass, which are better seen at the quarries beyond. At this quarry, the Onondaga limestone and the Oriskany sandstone are also exposed.

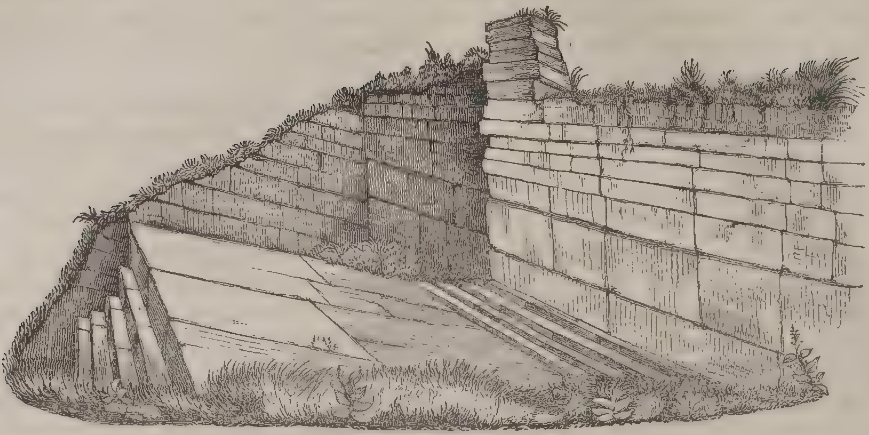
The third quarry from the outlet, shows nine layers. The fourth ascending layer is peculiar: it is three feet thick, and presents numerous oblique divisions like laminations; the angle of inclination being about 35°. The upper layer shows eight ranges of nodules of flint: they are here arranged in pairs, *i. e.* there is more space between every two ranges, than between each range. This fact may be general, but was only noticed at this quarry, from the unusual number of the ranges, and of the nodules of flint.

There are three quarries still further east, all of which show lower layers than those already noticed, the last of which exhibits the upper ones also. The different quarries, as well as the outlet from the Prison to the lower side of the Factory, expose about eight feet of the upper part of the water-lime group, about one foot of the Oriskany sandstone, over eight feet of Onondaga limestone, and twenty-seven of the corniferous, exclusive of its upper member, the Seneca limestone. At the last quarry, the lower part of the corniferous presents nine feet of rock, in which, as in numerous other localities, shale predominates over the calcareous material. This part is usually more fossiliferous than the calcareous portion.

The last place in the district where the corniferous limestone is quarried, and where it ends, is at Springport, on the south side of the village. The lower layers are exposed at Mr. Ham's quarry, and are but a few feet above the lake. Between the layers there is considerable shale, and the whole mass is of an exceedingly dark or black color; the layers are both thin and thick, and the former are used for flags.

At a short distance to the south of Ham's quarry, is the one which belongs to Howland, of which the following wood-cut is an excellent representation. It shows the upper part of the same limestone, with the parallel nodules of flint, upon which is the Seneca limestone. The layers of both are well defined, and show a dip wholly unusual as to angle, being about twenty degrees, the direction the usual one to the southwest. This quarry is of great interest, for the joints maintain their vertical character, those of the two rocks being coincident. From the fact that the joints in all the other rocks, as well as in the corniferous of every other locality, are perpendicular to the horizon, it follows either that they were produced subsequent to the change in the dip of the rocks, or that they are anomalous phenomena. The wood-cut shows the inclination of the layers, and the vertical joint. The upper part of the quarry is composed of the Seneca limestone, and the lower of the corniferous limestone.

34.



View of Howland quarry, from a drawing by R. C. Taylor.

The Seneca limestone is the terminal part of the corniferous limestone, and of the great range of upper limestone rocks. With it, also, the Helderberg division of the New-York system ends. Through Onondaga and Cayuga counties it is abundant, and extends into the fourth district, where I first observed it. In all its localities, it rests upon the corniferous limestone, without any obvious mineral line of separation. The reason for considering it to be a distinct rock, was the finding it in Seneca county the first year of the survey, unconnected with any other rock, and subsequently in the third district, containing in both districts the Strophomena lineata in great abundance, none of which had then been discovered in any part of the district below this rock; but since that time, one specimen has been found adhering to the flint of the corniferous in the State Collection. This rock is the geological point at which a fossil appeared for the first time in the district, and in myriads which disappear with the rock, not one being found in the marcellus shales above. This fossil, or one similar to it, is in great abundance in the Hamilton group, but no comparative examination has yet been made to ascertain their relationship.

Fossils, as a character to designate rocks, are of two kinds: In the one kind or character they are limited to the rock, like the Strophomena deltoidea of the Trenton limestone, the Pterinea carinata and Cyrtolites ornatus of the sandstone shales of Pulaski, the Pentamerus oblongus of the Clinton group, the Pentamerus galeatus of the limestone of that name, the Atrypa elongata of the Oriskany sandstone, and a host of others which the facts of geology show are fixed to a rock, mass, period or era. The other kind were a longer lived race, having had more enduring powers, appearing and reäppearing in the same locality; and as a geological character, their utility arises from the limitation of their range, the mineral nature of the rock, and its association with others whose existence was limited to the same time and place. Some of these fossils are found in two or more periods or rocks, passing over one or two intermediate ones; like the Strophomena semiovalis, which in this district is found in the Trenton limestone and the sandstone shale of Pulaski, the Utica and the Frankfort slate and sandstone intervening. Others are more like the Strophomena depressa, which first appears in the Clinton group with the lower iron bed; disappearing through the whole period of the salt group, water-lime group, and pentamerus limestone; reäppearing in the Catskill shaly limestone, and continuing upwards, but with intermissions, to the corniferous limestone where it ends; not a trace of it being seen from that rock, in any of the many which succeed to it. From the twofold character of fossil species, care must be used in determining a rock by them. The species must be of the kind whose range is limited to a single rock, and not of that which extends through two or more rocks; and attention should also be paid to the number, whether few or many.

Besides the Strophomena lineata, there are but few fossils found in the Seneca limestone at the west end of the district. The Odontocephalus selenurus, which at Auburn appears in the layers containing hornstone, is found in the Seneca limestone at Howland's quarry at Springport; and thus, as to this fossil, unites the two.

At the east end of this district, I have not been able satisfactorily to identify this rock. The upper layers of the corniferous limestone at Cherry-Valley, and at the Helderberg near Clark's, those which are above the range of hornstone layers, are probably to be referred to the Seneca limestone, having found a single specimen of a strophomena resembling the lineata at each of those places in the upper layers. There is no advantage in retaining the rock, except as relating to the fossils which at the west are contained in it in great numbers, as a ready and well defined mark of the termination upwards of the Helderberg series, and highly convenient at the west end of the district on that account.

The Seneca limestone is quarried at Marcellus, a few rods to the southwest of the village. The three upper layers, which lie immediately under the shale, are the ones which are extracted; they are about seven inches thick. Below them are thicker layers, but they do not answer so well. The whole abound with the Strophomena lineata, and form the straight surfaces of the joints of the rock: it forms a wall like hewn stone.

The general color of the rock is of some shade of brown-black, usually becoming an ash grey when long exposed. At West hill, its fossils often show a pink tinge, which is also exhibited by some of those of the corniferous limestone.

In the cabinet of David Thomas of Scipio, there is a bone similar in character to those noticed under the head of Onondaga limestone: It is about $7\frac{1}{4}$ inches in length, and $1\frac{1}{8}$ in breadth; it is curved, and terminates in a point at one end; one side is round, the other angular. It was found in this rock to the south of Waterloo. It was noticed by Mr. Hall as an Ichthyodorulite. This is the third rock in succession at the west where these peculiar bones have been discovered; it being remarkable that nothing of an intermediate character to the animal which bore them, and the crustaceans, have yet been discovered in the State, or elsewhere that has been made known.

*List of Fossils from the Reports, etc. of T. A. Conrad, identified and named up to this period, which are found in the Corniferous limestone.*

TESTACEA, OR SHELLS.

Delthyris acuminata.
Strophomena undulosa.
— rugosa.

Platyceras dumosum, formerly Pileopsis tubifer.
Cyrtoceras trivolvis.
— matheri.

CRUSTACEA.

Odontocephalus selenurus.

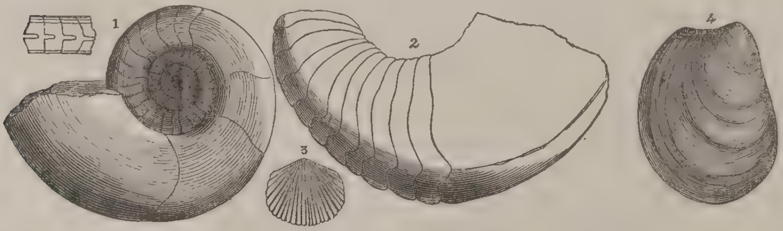
## 21. MARCELLUS SHALES.

*Commencement of the Pyritiferous Rock (or Third Greywacke) of Eaton.*

TWO DIVISIONS—Lower, calcareous, fossiliferous and somewhat fissile; the upper, shaly, breaking into small irregular fragments.

Color black, usually dark brown when altered. It is the first mass which rises upon the top of the Helderberg series of limestone, and is coëxtensive with it. It greatly resembles the Utica slate in mineral character, and could readily be confounded with it.

35.



No. 1. Expanded goniatite (G. expansus), natural size; the segment above represents the back of the chambers, which differ from No. 2.
2. Segment of the Marcellus goniatite (G. marcellensis), reduced about one half in size.
3. Limitary orthis (O. limitaris).
4. Marcellus cypricardites (C. marcellensis).

These shales extend east and west through the district, commencing near the Hudson, and ending on Lake Erie. They are conveniently divided into two masses, from the presence of limestone and fossils in the one, and their absence generally in the other. The limestone is very impure, of the same dark color of the shale, rarely forming continuous layers or beds, but generally interrupted flattened masses, with interposed slate or shale; the masses presenting curved surfaces, showing that the cause of the coming together of their particles was the same with that which produces septaria, the character of which they often assume as to external form, and also as to the cracks or internal divisions, or septa, from whence the name of *septaria* was derived. The whole of the layers and septaria, and shale, was a deposit of argillaceous and calcareous mud in variable proportions. Where the calcareous material was abundant, it produced layers; where but in small quantity, it separated into globuliform masses or septaria.

The upper shales are not so highly colored as the lower ones. Near Marcellus, and in other parts of Onondaga where best observed, they show no fossils for one or two hundred or more feet where thickest. They are disposed to separate, when long exposed, into small thin edged fragments, the result of a peculiar accretionary structure; the fragments often exhibiting stains in spots from iron rust, and also minute crystals of gypsum, the effect of the action of decomposed pyrites and limestone particles. The upper mass appears to diminish in thickness east and west from Marcellus.

There are but few fossils found in this rock, but most of these are peculiar to it; among them is

No. 1 of the wood-cut, the *Expanded goniatite*, the whorl enlarging rapidly towards the mouth.

No. 2. The *Marcellus goniatite.* This species is more abundant, and some are of great size. A fragment of one was found, which, when perfect, must have been nearly a foot in diameter. Both specimens are in the State Collection. The goniatites were found only in the two upper limestone layers of the lower shales, and in several points between Oneida creek and Marcellus village. Were the rock broken or quarried, numerous specimens might be found of this fossil. A segment is given, merely to show the difference between the two species.

No. 3, is the *Limitary orthis.* It is very abundant in some localities, and appears to be coëxtensive with the shales and the lower part only of the Hamilton group, and to be in greater number near the junction of the two, from whence its name. It is exceedingly rare where the mass is thick; not having been noticed near Marcellus, where the mass is at its maximum.

No. 4. *Marcellus cypricardite* (cast).

There are several other fossils: For example, an avicula, which resembles a posidonia; a large orthocera, the *Marcellus*, which is about a foot in diameter, and is associated with the goniatites; also a more slender one in the shale, but the characters obscure; a lingula, and several small shells not yet investigated.

Some portions of the lower shales are black and friable from small carbonaceous fucoids or graptolites, the forms too imperfect to determine without minute and patient examination. From such bodies obviously the seductive particles of carbon were derived, which made this mass so great and general an object of search for coal throughout its long east and west range through the State.

The occurrence of coal in very small quantities is a very common character of the lower shales. Along the whole line of its outcrop, every few miles present an excavation which was made in these shales, in hope of discovering coal. The dark color, and the actual presence of this fossil product, were considered sure signs of its existence in body. The failure to discover coal has been no small disappointment; so great would have been the immediate gain to individuals and the public, placed in so accessible a position as it would be for home use and commerce.

The first favorable point to the east of the district, for the examination of the lower shales, is at Cherry-Valley, on both sides of the valley. At the ashery just below the village, it rises upon a surface of limestone, showing a series of irregular but parallel beds of very impure limestone, their surface on both sides presenting rounded elevations and depressions; each bed separated by friable slaty shale, containing iron pyrites, and numerous arborescent fucoids, with smooth surfaces, and about six inches in length, apparently of one species. Above these thin layers, there is a mass of about five feet thick of the same kind of limestone, upon which are the upper shales, rising to the height, as may be seen up the brook, of one hundred feet.

The creek on the opposite side of the valley exposes a greater mass of the rock, and fossil shells are more numerous than at the ashery. There is there a less quantity of limestone, and greater tendency to show itself in the form of septaria. The upper thick mass forms the low falls of the brook.

The road west over the limestone range through Springfield, and the road across the same to Cooperstown, show at a little distance low hills, the base of which is of the lower mass: several attempts for coal were there made.

The hills which range on both sides of Bridgewater flatts, resting upon the corniferous limestone, are composed of these shales. On the land of Paley B. Babcock, there is an excavation for coal; portions of the shale being highly glazed, with here and there an accumulation of coal, rarely exceeding a few inches in length and a quarter of an inch in thickness, and an inch or so in width. In the slate is the Slender orthocera, a modiola, etc. This excavation is near the beautiful Elm, which for a great distance attracts the eye by its height and graceful form.

Further south, about a mile and a half distant, another attempt for coal was made, at a higher level, on the land of Peter Crandel, but with no more success. A portion of the shale, from its color, was supposed to be plaster. It was ground for such, and spread, and with benefit as was said. No doubt a like result would have been observed, had any other shale rock been used.

Near Waterville is the digging made by the Messrs. Bacon, and noticed by Mr. Conrad. It is by the side of the road to Cassville, and by the side of a brook up which for some distance the Marcellus shales appear. They have a tendency to massiveness; in parts contorted, and glazed with coaly matter, showing specks or particles of coal in the joints or cracks in the rock, the parts where it is usually seen in this rock.

Above the falls on Oneida creek, extending to the saw-mill, is the best locality for the examination of the lower shales and its limestone associates. They begin near Foster's mill, resting immediately upon the Seneca limestone. The lower part of the shales show a series of parallel layers or beds of impure limestone, with numerous interruptions, many of which have the outward form of septaria. Above these are two layers, which are straight, and about three feet thick, and from this place appear to have been continuous to near Marcellus in Onondaga county. In the lower layer, the genus Goniatites first appears, with the Marcellus orthocera. These fossils were seen at the different points where these layers appear west, and the species noticed in the third district are confined to this rock.

Near to the saw-mill are two excavations for coal; at the upper one, the Marcellus lingula is found, and the common small avicula which resembles a posidonia. Well characterized septaria are found on the east bank of Chittenango creek, near the high falls. They contain sulphate of strontian, carbonate of iron, etc., in their septæ.

A boring of one hundred feet for coal was made in the Marcellus shales by Mr. Sage, near the road from Chittenango to Cazenovia. Near Manlius square, two excavations were also made for the same object; one on the farm of Mr. Nettleton, near the turnpike, about a mile west of the village; the other a little further west, on Mr. Marsh's farm. The one at Mr. Nettleton's is by the side of a brook; the shale is much contorted, owing to crystalline limestone which is mixed with it. Both are very black from coaly material, of which minute veins are to be seen. At this place there is a fault, the first seen upon the upper range going west. It is quite local, owing no doubt to the same cause which has produced a similar one at Marcellus. At Nettleton's, the shale and the limestone rock upon which it rests range side by side as parallel masses, and not as they were originally formed, the bottom part of the slate being on the level with the top of the limestone. At Marcellus, numerous sink-holes exist in the limestone, which forms the base of the shales; and far below the level of that rock, many large springs of water make their appearance in Nine-mile creek near by; these show subterranean passages or excavations, into which portions or blocks of upper masses have been let down to a lower level, as we there find. A little west of Nettleton's, in the road and in the field on the north side, are large fragments of the black limestone, containing goniatites; they were ploughed up, and put aside for wall stone.

Between Onondaga hollow and Marcellus, the turnpike passes over the lower shales, where it rises to its greatest elevation. The shales form the top of the hill east of Marcellus, extending along the pond, and rising with the upper shales to a considerable height on the south and west side of the village. At the quarry of Seneca limestone, there is five feet of shale upon that rock; then a layer of very impure limestone, breaking with a curved shaly fracture, containing the Marcellus lingula and a small orthis, which is also found in the road, but not yet named. Along the pond to the southeast, the upper thick layer is seen, with fragments of rather imperfect specimens of goniatites, and orthoceræ such as were before noticed.

The outlet of Owasco lake at Auburn is in the lower shales. In deepening or enlarging a portion of it, a considerable number of very regular formed septaria were thrown out, a few of which were to be seen in the gardens of the village.

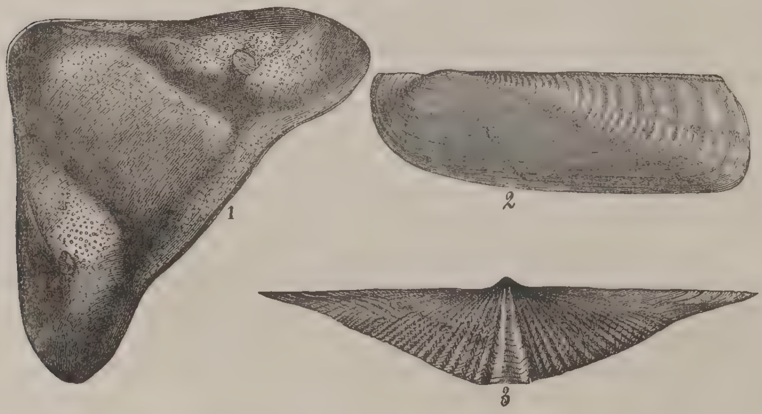
These shales may be traced continuously from the east to the west end of the district; the line of continuity being only broken by the valleys, through which the many creeks and brooks flow at right angles to its direction, or line of northern outcrop; the points noticed in the report being such only as appeared to be the most prominent or important.

## 22. HAMILTON GROUP.

It embraces all the masses of the Annual Reports noticed under the head of Skaneateles shales, Dark slaty fossiliferous shale, Compact calcareous blue shale, Olive shale, Ludlowville shale, Encrinal limestone, Moscow shale, Shales near Apulia and Sherburne, and Cazenovia groups.

(No. 8. Pennsylvania Survey.)

36.



No. 1. Head of Dekay's dipleura (D. dekayi). No. 2. Undulated orthonata (O. undulata).
No. 3. Sharp-pointed delthyris (D. mucronatus

This group takes its name from the town of Hamilton in Madison county, which contains no other rock, and where the best opportunity exists of examining some of the important members of which it is composed, and where its fossils are in great abundance. To many the name is acceptable, as it perpetuates the counsellor of the right hand of Washington.

The Hamilton group, for the present, includes all the masses between the upper shales of Marcellus, and the Tully limestone. That it may be divided to advantage, admits of little doubt, as might be supposed from the annual reports, and from its thickness; but up to the present time, no advantageous or satisfactory division has been suggested, except for the west end of the district: the arrangement adopted, though less satisfactory, is, from its simplicity, of more ready application, and subserves all present purposes.

The group is of great thickness; in no part probably less than three hundred, and swelling to seven hundred feet. It commences near the Hudson, and extends to Lake Erie. It is therefore important from its thickness, and for the extent of surface which it occupies in New-York. It consists of shale, slate and sandstone, with endless mixtures of these materials. They form three distinct mineral masses as to kinds, but not as to superposition or arrangement, though generally the sandy portion is the middle part of the group.

The first in the order of tenuity of particles, is rather a fine-grained shale, often fissile or slaty; color some shade of blue, usually dark or blackish.

The second is a coarse shale, often mixed with carbonate of lime. Its color blue or dark grey when fresh, but becomes of an olive or brown by long exposure to the weather: the color due to manganese. No tendency to separate into regular layers whatever; but where a mass has been long exposed, it shows numerous curved divisions, the curves very short and irregular, and the parts horizontally arranged.

The third kind is not so common as the two first. It is a well characterized sandstone, but more or less mixed with either of the two others. It is often in layers, though rarely straight, and usually short or interrupted; sometimes mixed with carbonate of lime. The colors of this kind are more various; brown of various shades, olive, greenish and yellowish.

The group generally is deficient in building materials, the shale of the first kind readily crumbling by exposure to the air; the two latter kinds alone furnish building stone. The best is where limestone forms the cement, and sand is in the greatest abundance. So rare is the occurrence of regular layers in the group, that their absence is a good negative character of it, and its brownish color externally or where weathered, a good positive one of the group generally.

It abounds in fossils, such as shells, corals, trilobites, fucoids, and a few plants resembling those of terrene origin. It is admirably characterized by its fossils; numerous species, and even genera, commencing with the group and ending with it. In organic remains, it is the most prolific of all the New-York rocks. Among the numerous fossils by which the group is readily recognized, are the three figured in wood-cut 36 *ante.*

No. 1. Head of *De Kay's dipleura* (D. dekayi), that part being figured from its number and characteristic form, the entire ones being very rare. The head in some measure resembles that of the Dolphin-head trimerus of the Clinton group, or more closely the one in the Niagara sandstone; but the difference is considerable in the form of the snout, and the parts around the eyes being more full or protuberant in the dipleura. The genus Homalonotus, figured in Mr. Murchison's work, and which occurs in the same position in England, resembles the dipleura, but differs from it in the tail being divided into three lobes or parts as in the Trimerus, while the Dipleura is unilobed; in other respects, there is something like identity. In Ladd's quarry on the Chenango canal, north of Sherburne village, I found on a thin slab two or three small perfect trilobites, with the same structure of the tail which belongs to the English genus, associated with the

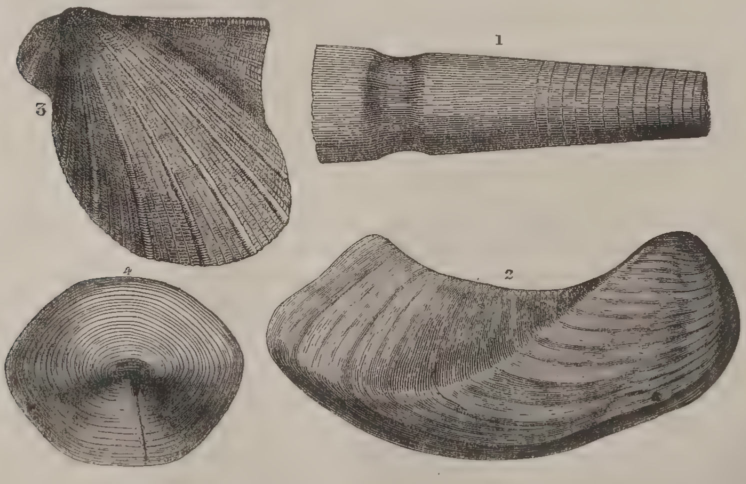
Dipleura of the same size, the largest not over an inch in length. The only difference observed between them, was in the tail. This fact settles the question of difference as to genus, which with the British geologists appeared to be doubtful. The specimens are in the Collection of the State. With the exception of two instances only in an upper position, this trilobite is confined to the Hamilton group. It is rare in the fine slate or shale, but common in the coarse shale and sandstone.

No. 2. *Undulated orthonata.* This very beautiful shell is confined altogether to this group. It is not an abundant one, but is found from one end of the district to the other, showing at least diffusion of its individuals. The O. carinata is also found in this rock, but it is rare.

No. 3. *Mucronated* or *Sharp-pointed delthyris.* This truly graceful shell exists in great numbers in the group, and rather generally diffused. It takes its name from its pointed extremities. It has the appearance at first sight of a butterfly, and is often taken for such. The form of this species is not always so much extended in the direction of the line of the hinge, as in the one figured; those of this kind probably having obtained to their perfect state as to form, whilst others are shorter, and of greater breadth from the hinge outwards, appearing at first view like distinct species, but no other difference exists except a few additional ribs where elongated.

In the Report on the fourth district, there is a wood-cut figure of the Microdon bellastriata, and of the Bellerophon hamiltoni, both very characteristic fossils of the Hamilton group. The wood-cut No. 37 below presents also four common and exclusive ones, selected from numerous others which belong to this group.

37.



No. 1. Constricted orthocera (O. constrictum).
2. Recurved cypricardites (C. recurva).

No. 3. Flabella avicula (A. flabella).
4. Great orbicula (O. grandis).

No. 1. *Constricted orthocera* (O. constrictum), which is very peculiar, from the part narrowing towards the mouth, and then expanding as if a ligature had there been applied.

No. 2. *Recurved cypricardite* (C. recurva), is a very characteristic, as well as a singular shaped fossil; like numbers 1 and 4, it is found only in this group.

No. 3. *Flabella avicula* (A. flabella). It is an exceeding numerous species in the group, and is confined to it. It is readily known by its well defined form, its seven or eight large ribs, and its fine or small intermediate ones. The genus Avicula abounds in this group; no less than fifteen species being already named, and several others in the State Collection yet unnamed. Among the more common ones, is the *Parity avicula* (A. parilis), formerly the Monotis princeps. The *Erect avicula* (A. erecta) is also a common one, and is confined to this group.

No. 4. *Great orbicula* (O. grandis). The under part only of the upper valve is figured. Near the centre, there is an indentation which resembles the navel of the human subject, and from which a slight groove passes towards the circumference of the shell or disk. This fossil is readily recognized by the nearly flat circular form of the upper valve, and by the cap-like form of the lower one.

The fossils figured in the two wood-cuts will serve to give some idea of those which are contained in this group; others will be noticed at some of its prominent localities; and a list of all those which have been named to this time by Mr. Conrad, will be given at the end of the group. There is no one of the groups which contains so many fossils that are restricted to it.

The Hamilton group is confined entirely to the counties of Otsego, Madison, Onondaga, Cayuga, Herkimer, Oneida, Cortland, Chenango, and Tompkins. In the four first counties, it covers considerable surface; in the last five, but very little.

In Otsego county, the group covers the hills on both sides of the valley at Cherry-Valley, extending thence over the whole of the town to the south, forming the surface rock of Decatur and Westford. It covers the whole of Middlefield, and its north extension, not named upon the maps of the State; also the upper part of the town of Milford; all but the southwest corner of Hartwick; the whole of the town of Otsego, extending up to the head of Schyller's and Otsego lakes. It covers the whole of Burlington, Edmeston, Plainfield and Exeter; the lower part of Richfield, and the northern part of Pittsfield and New-Lisbon.

In Madison county, it forms one half of its area, covering the whole of the town of Brookfield, excepting a triangular projection towards the southwest end. It covers the whole of the towns of Hamilton and Madison, the larger east half of Lebanon, the greater part of Eaton, the west-southwest portion of which is covered by higher rocks. It covers the extreme south part of New-Stockbridge, the lower half of Smithfield, the line passing from southeast to northwest; all of Fenner, excepting the north and the northwest part. It covers the largest portion of the town of Cazenovia, extending on the west side from its south line, to about the head of the lake. The lower part of the town where it joins on Nelson, contains higher rocks; the dividing line between them and the Ithaca group passing by the northwest corner of Nelson, and turning round by the northeast, being the only part of Nelson which contains the group as surface rocks. It extends into De Ruyter from Cazenovia, diminishes in width, and enters the northeast end of Cortland from De Ruyter in a narrow strip.

In Onondaga county, it covers the greater portion of the town of Pompey, the north end only having other rocks. It covers the whole of Lafayette except the northeast end, the whole of Otisco, the greater part of Onondaga, the lower half of Marcellus, and all of Skaneateles but the northern portion. It forms the greater part of Fabius and Tully, and a part of Spafford. There are a few exceptions to be made in this county, such as the Tully limestone in Pompey, Otisco and a few other localities, which in a practical point of view are of little consequence, as this limestone covers but small areas.

In Cayuga county, the group covers the greater part of Owasco, the northern portion of Sempronius, the largest portion of Fleming, the northern and eastern part of Scipio, the southeast half of Springport, the greater part of all Ledyard, extending thence along the lake to the county line. From the great depth of the valley at the head of Owasco lake, the group appears in the side-hills to the south of Moravia.

No part of the group appears in Herkimer county, except in the town of Winfield; and in Oneida county, in the towns of Bridgewater and Sangerfield, extending into the southwest part of Paris-hill, and the southeast part of Marshall, and also in the southern part of Augusta. It terminates or caps the high hills or ridges which come up, as it were, from the south.

In Cortland county, it is but very partial, and is found only in the north part of Truxton.

In Chenango county, it forms a strip along the Unadilla river, of about three miles wide at the north line of the county, and terminates a few miles south of North New-Berlin. It covers the larger northern half of Sherburne, and a portion of the northeast part of Smyrna.

In Tompkins county, it is found only on Cayuga lake, being a strip which comes to an end about three miles below Ludlowville.

At present a few localities only will be mentioned of the shales and the more solid or harder masses, reserving the detail for the counties, and to those where the group occurs; first enumerating the different parts observed on Cayuga lake, some of which have not, however, been recognized towards the east end of the district.

The first rock going south on the lake, after passing the low clayey ground to the south of Springport, may be considered as the dividing line between the Marcellus shales and the Hamilton group. It is a dark slaty fossiliferous shale, with numerous individuals of the Orthis umbonata of Mr. Conrad, but usually small, associated with the Limitary orthis (O. limitaris) also numerous, etc. It shows about six feet of a brownish black impure limestone. This part forms the small rise about half a mile or more below Levana. It appears in the road from Springport to Levana, at Crise's brook; on the road to Auburn from Springport, two miles southwest of Half-acre; to the northeast of Skaneateles on the road to Marcellus, and on the north side of Pompey hill, etc. The *Umbonated orthis* (O. umbonata), which occurs in myriads in this part of the group in Cayuga county, was not noted as having been seen in the same position at the east end of the district.

From the north of Levana, no rock could be seen on the shore, until south of Aurora; there the harder variety appears. It is between these two points that the shales of Skaneateles, of the Report of 1840, are placed, being the second observed mass in the ascending series; they are less fissile, more calcareous, fossils more numerous as to kinds and individuals, than in the mass to the north of Levana. It is in this part that the Mucronated delthyris, Bufo asaphus, Linear strophomena, Umbonated orthis, etc. first appear.

The harder variety, on the lake to the south of Aurora, forms a bluff rising near the water's edge to the height of twenty or more feet. Its color by exposure is of a brown olive, and is similar to the greater part of the harder shale of this group, and known in the Reports under the name of Olive and Ludlowville shales. The more common fossils observed at the bluff were the Concentric atrypa, and those of the Skaneateles shales. These shales are of considerable thickness upon the lake; falling, rising and disappearing as the direction of the lake changes, as will be explained under the head of Tully limestone. They present numerous bluffs, and are finally lost under the encrinal limestone below Ludlowville. It contains numerous fossils, among which, besides those already enumerated as existing towards Aurora, are the Concentric cypricardite (C. concentrica), Corded cypricardite (C. subtenta), Wrinkled cypricardite (C. rugosa), Eggform inoceramus (I. oviformis), Keeled strophomena (S. carinata), Undulated orthonata, with numerous others belonging to the group, a few of which only have been named.

As before mentioned, these shales extend to the encrinal limestone. This is a mass of impure limestone, rather a tough rock, usually of a brownish color, from three to four feet in thickness, and containing in most parts of its range along the lake, numerous fragments of encrinal joints or disks of crinoids, whence the name. It contains other fossils, but none with certainty noticed, which differed from those of the group. It makes its appearance in going south, first in the ravines near Ogden's ferry, and along the lake shore to the south of the creek at Ludlowville. It resists the action of the weather, and projects from the side-hill and ravines, and forms the first falls in the ravines. This mass does not appear to extend far east, not having with certainty been recognized beyond the borders of Cayuga lake. South of Borodino, a ledge of encrinal limestone crosses the road; but it has the thickness of the Tully limestone, and the Genesee slate rests upon it.

In the fourth district, the encrinal limestone appears, from the account given of it by the Geologist of that district, to be a persistent mass; appearing at various points between Cayuga lake and Lake Erie, at its line of outcrop.

Above the encrinal limestone, are the Moscow shales of Mr. Hall. The color of this mass is of a darker blue along the lake; it is composed of finer particles, and is also more calcareous. It extends to the Tully limestone, which is the termination upwards of the group. It contains numerous fossils in common with the parts below the encrinal limestone, and may contain some which have only been found in this shale, but which I am not able with certainty to designate. In the fourth district it would appear that there is a difference, and that difference will be made known in its report. There are some fossils which certainly are more abundant in these shales at Ludlowville than in those below, along the lake; such as the

Orthis resupinata or the *Upside-down orthis*, Bufo calymene, and the genus Gryphæus; but this fact does not hold to the east of the lake, where their range is more extensive. So also with the Recurved cypricardite, which I only found in that part, on the lake, under the Tully limestone at Ludlowville. This fossil holds a lower position east, being one of the numerous ones near West-Hamilton, in the sandstone portion of the group. These facts are given to show the difficulty of establishing differences in the group to the east of Cayuga lake, and not that differences do not exist to the west of it; for as shale greatly predominates at that end of the State, and mixtures at the east end, an obvious constancy as to the position or vertical range of fossils may exist at the one, and may not exist, or not be very apparent at the other.

The Moscow shales may be seen between the two limestones in any of the ravines, or small brooks which flow into the lake from Long point to Hemrod's point, and from thence along the lake shore to Bloom's lime-kiln. Similar shales, but generally harder, appear under the Tully limestone at Montville, Moravia, Vanetten's mill in Sempronius, Tully four corners and Tinker's falls; at all which localities the Tully limestone appears, and beyond also where the limestone has run out, as at Smyrna, the creek at Sherburne, and at North New-Berlin; or at least we find at all these places a more fine-grained and softer shale, with numerous and similar fossils, succeeding harder shales and sandstone; but whether they are the same with the Moscow shales, will depend upon a comparative examination of their fossils, which has not yet been made, and which must be subject matter for the Report on the Fossils of the State.

From the great thickness of the group, and the extent of surface which it covers, it presents numerous points for examination; deep and broad valleys being excavated in the group, into which numerous brooks, flowing from the hill-tops, discharge their waters, often presenting one or more cascades, where a harder portion of the group has arrested the destructive action of their waters.

In Otsego county, among the numerous favorable points for examining some portions of the group, is the brook by the ashery just below Cherry-Valley village. The part at the falls consists of the coarse shale, and contains numerous fossils, such as the two varieties of the Mucronated delthyris, the Concentric atrypa, Keeled atrypa, Undulated conularia, Cryphæus, etc. Higher up on the hill are harder and sandy varieties of the group, but too much covered up to admit of much examination.

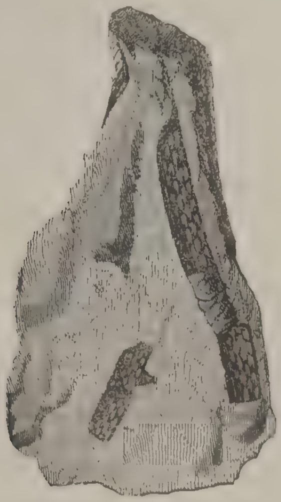
The brook on the west side of the valley, two miles lower down, exhibits the finer and more fissile shale, then the coarser, and finally the sandstone variety towards the top of the hill, which appears as a ledge, showing numerous specimens of the Flabella avicula, the common one of the group.

Between Clarksville and Cherry-Valley on the east side, and on the side-hill, the coarse shale appears with the fossils, among which is De Kay's dipleura, parts of which are frequently met with from the first district to Cayuga county.

On both sides of Otsego lake, the same shale appears in numerous points, and abounds with fossils, among which we find the Ridged posidonia, Mucronated delthyris, Concentric atrypa, Keeled atrypa, Cryphæus, etc.

On the road from Cooperstown to Burlington, are some small points of interest, one of which is near the summit elevation about three miles from the latter village. There the first impression of a plant was found, in the ascending order of the New-York System, whose external markings or structure resembled those of terrene origin; a fact of no small importance in the history of such plants. The same kind were subsequently seen with Mr. Mather on the road from Summit to Hinsdale, in the first district, where they are comparatively in considerable abundance. A good specimen was also picked up in a quarry near the forks of the Unadilla. The wood-cut below gives but an imperfect idea of it. The plant shows about three small protuberances of a lentiform shape, placed nearly side by side.

38.



In Madison county, the greatest exposition of this group is in the neighborhood of West-Hamilton village; various openings having been made in the hill back of the Seminary, from the bottom to the top. The lower part of the hill shows irregular layers of sandstone and shale, the former in less quantity; above which are coarse shales of different kinds, extending to near the top of the hill. Back of the Institution, at a little higher level, the shale which was quarried has fallen into fragments. At the top of the hill, about twenty feet of sandstone and shale are exposed, a considerable quantity of stone and refuse having been thrown out. Fossils are numerous at the quarry, among which are the Mucronated delthyris, the one figured in the wood-cut being from this locality; also the Flabella avicula, Keeled atrypa, Syrtalis strophomena, Plebeian atrypa, Prow delthyris, De Kay's dipleura, etc. At the lower quarry, fragments of the plant figured in wood-cut 40 are often found.

At the upper quarry, I found a fragment of the external impression of a singular and beautifully wrought crinoidal fossil, the most so of any one hitherto seen in the system, and unique as to kind. A cast of it shows a connected surface, upon which six detached circular forms were placed, having the appearance of medallions; their whole surface, and sides which are inclined, being highly wrought with minute markings like gothic tracery. Three were of the same size, rather over an inch in diameter, slightly ovoid, and clustered together; one only was entire, the two others having been broken off, but leaving sufficient to show their size and character. The other three were small; two being nearly equal, and each less than the fifth of an inch in diameter; the third, double that diameter; and all three were placed together in an angle formed by two of the larger ones. Near the centre of the largest and perfect medallion are five branching arms, like those of an asteria or star-fish; between two of which, and those which are most expanded, is a star, which probably was the mouth of the animal. As this is the first instance in which distinct crinoids have been found clustered together so as to form one system, it therefore establishes a new genus, for which the name of *Agelacrinites* is proposed, from *agele*, a herd or group, and *hamiltonensis* for the species; in common language, the *Hamilton agelacrinite*. A wood-cut would have been given of it, had there been time so to do.

In most instances, the calcareous particles of the testaceous fossils have been removed, and their place in part occupied by hydrate of iron, forming a handsome contrast with the yellow grey color of the rock, which it assumes after exposure or when altered.

The ledge at the Seminary hill continues to Chenango county, appearing there a few feet above the canal, being quarried at Mr. Ladd's; where also the same fossils, and in great abundance, are to be obtained.

In the excavation of the feeder at Hamilton, a considerable mass of the harder and somewhat calcareous shale was thrown out; this resists in a great measure the action of the weather. Some of the smaller species of cypricardites are quite numerous. At this place a few of the common cyathophyllum were seen, and also a columnaria, etc. At the feeder, many heads and other parts of the Dipleura were found in the loose blocks scattered about.

The locality of the greatest interest for fossils near West-Hamilton village is the side-hill upon which Deacon Burchard's quarry is seated, about two miles distant. There is a lower quarry to the left, in hard dark shale, in which there are a few species, but the individuals are rather numerous; among which is the impression of a beautiful arborescent coral often met with in this group, and in no other.

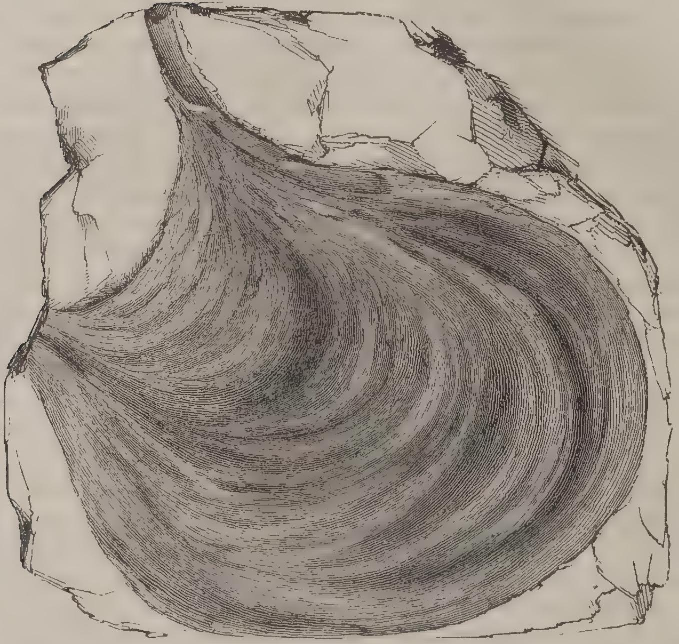
The quarry of the Deacon is near the top of the hill, and consists of thin interrupted layers of light-colored sandstone and hard shale, abounding in fossils; among which are the Flabella avicula, Erect avicula, Rugous cypricardite, Plebeian atrypa, Syrtalis strophomena, etc.

A quarry of some interest in this group, is on the farm of William Lewis, not far from Solsville. It was opened for the Chenango canal. The rock is the hard calcareous grey shale, being the upper rock of the hill. There are no regular horizontal lines of division whatever, but those which are curved or irregular only. The vertical joints are remarkably well defined, giving a wall-like appearance to the rock. This is a common feature to many parts, and in many places where the group exists. The joints are in two directions, nearly at right angles to each other; one N.E. and S.W. A rock of its nature would appear unsuitable for the purposes required; yet the surface of the quarry is good evidence that it is slow to change, except in its color, and the numerous fragments upon the surface of the soil show a disposition rather to wear away than to decompose. This quarry is rather rich in fossils as to genera and species, but the individuals are not numerous. It is one of the two localities of the *Maximum phragmoceras*, formerly the *Cyrtoceras maximus*, and where the greatest number and the best preserved specimens were found. The other locality is on the road between Waterville and Bridgewater. This fossil is the largest coiled chambered shell which is found below the lias of Europe. There is a smaller species, which is more expanded from the chambers towards the mouth, and which was found also at Ladd's, etc. Lewis' quarry is one of the four or five localities of the Punctated goniatite (G. punctata); also of the Undulated conularia, the common aviculæ, such as the Flabella, the Erect, and the Parity; also the Triquetrous pterinea (P. triqueter), Great orbicula, Channelled cypricardite (C. alveata).

The singular and graceful forms first noticed in the cauda-galli grit, reäppear in this group, and are common to many localities. The forms are better defined in this rock than in the lower one, and the parts are all united or confluent; showing, in other words, a continuous surface, and not one of detached parts, either real or apparent, as in those of the other rock. A common form in this, is one which resembles a curtain and its folds, supported at both ends; one raised a little higher than the other, less space being between the ends than in the depth of the folds or curtain, as in the succeeding wood-cut, the original of which is from Lewis' quarry. It is furnished also with a stem, which, with the other characters they present, fully establishes their right to be considered as Plants; and from their great number, and their associates being oceanic, they must be of like marine origin.

In the wood-cut on the next page, is a specimen from Lewis' quarry, showing a stem, and the curtain-like folds.

39.

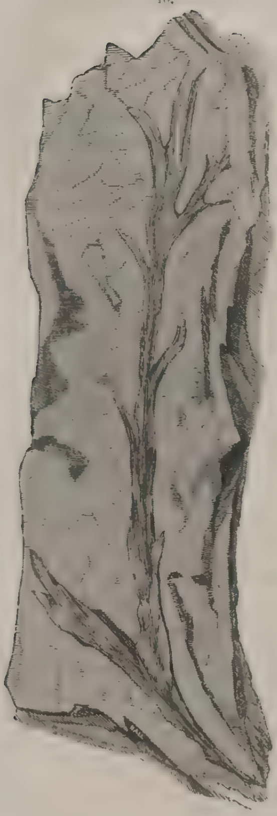


The hills around Cazenovia village are chiefly composed of the coarse shale, similar as to kind and fossils with those of Lewis' quarry, etc. They are well exposed in crossing the hill to the west, or on the hill-side to the southeast, and are the *Cazenovia shales* of Mr. Conrad. In mineral character, they constitute, as has before been said, the larger part of the whole group; they are of the kind which, when long exposed, become of a brownish color; they decompose or wear away very slowly, and are the common building material of their range.

*Chenango county.* Though but little is exposed of the group in this county, there are four points of interest. The first is Ladd's quarry on the canal, near Madison county line, and is the continuation of the range of West Hamilton; the quarry is rich in many of the fossils of the group, being in all respects like the quarry back of the Baptist College near the top of the hill. Considerable stone is here taken out, being convenient for transportation. The specimen in the Collection, showing the impression and part of a bone of a fish over two inches in length, and more than an inch in width, is from this quarry.

The next point is the falls and banks of Handsome creek, north of Sherburne. The water falls for sixty or more feet, and the sides of the creek expose about one hundred feet of the finer kind of shale. Many fossils, which are common to the mass below the encrinal limestone at Ludlowville, and the mass generally of the group, may be obtained at the creek.

40.



The third locality is in the road from Hamilton to Smyrna, where the two kinds of rock are seen, as well as the common fossils of Hamilton and of the shale of Handsome creek, the latter above the former.

The fourth point of exposition is at the creek and quarry west of North New-Berlin, which do not differ from those near Sherburne, but the rock is coarser and harder. At this quarry, the plant figured in wood-cut 40 was obtained. It is also found in other localities in this group, but the specimens or individuals are but few at each. The surface is smooth, with branches at irregular distances. Plants with similar external structure occur in the Catskill group under the coal of Pennsylvania, along the Susquehannah below Wilksbarre.

In Onondaga county are many places for the examination of the group, such as Buhr's falls on the edge of the town of Cazenovia, not far from the village of Delphi. The water falls sixty-four feet in height, the shale projecting at the falls like a huge buttress, which divides the water, and adds to the beauty of the falls. The shale is not of a fine kind, nor does it resist the action of the water. Fossils are very numerous at the falls.

*Pratt's falls.* These are to the northeast of the village of Pompey, on a branch of Limestone creek. The water falls over a few feet of the hard calcareous coarse shale, which abounds in the Flabella avicula, etc., and descends into a gulf of over one hundred feet in depth, excavated in the softer shale under the harder kind, in which fossils are numerous.

A favorable locality for observing the succession of shales and harder rocks and their fossils, from the base to the upper rock of Pratt's falls, is from the turnpike north, to Pompey village. The first rock seen in ascending the hill going south, is similar to the low bluff north of Levana, and contains the same fossils: next above it is what appears to be an orthis, which is flattened and deformed; then at a higher level are mineral and fossil products, not unlike those of Skaneateles; and again at the last rise before ascending to the village, is a quarry of hard sandstone layers, with Flabella avicula, Erect avicula, Rugous cypricardite, etc., and some very round or ball-like accretions about three inches in diameter.

Another locality is Tinker's falls, on the edge of Cortland county, in the town of Fabius. The water falls over the Tully limestone, exposing a thickness of about fifty feet of shale, containing numerous fossils. For a few feet below the limestone, the shale is highly colored with oxide of iron, owing to decomposed pyrites; and certain portions of it also show an efflorescence of gypsum.

There are other points of note, such as Gamble's mill in Otisco; the ravines near Amber; those of South Onondaga; the shores of Skaneateles lake, etc. etc.

In Cayuga county, the most favorable localities are the falls and gulf at Montville; the falls of Moravia, and the lake shore from below Levana to the county line of Tompkins; and thence south to Bloom's lime-kiln, between the mouth of the creek at Ludlowville and the head of the lake. The group is largely exposed along the lake shore, and the numerous small streams which empty into the lake; some of which, though very small, flow into deep and broad gulfs or ravines, exposing from fifty to two hundred and more feet of the group; such are those through the town of Genoa and further north, and also south to Ludlowville creek inclusive.

The group in Cayuga consists of both the fine and the coarse kinds of shale, the former being more abundant, and falling into fragments where much exposed; and the whole of the third or sandstone kind is wanting.

*List of Fossils from the Reports, etc. of* T. A. CONRAD, *identified and named to this time, which are found in the Hamilton Group.*

Delthyris mucronata.
— duplicata.
— audacula.
— prora.
— acanthoptera.
— fimbriata.
Strophomena syrtalis.
— inequistriata.
— carinata.
— demissa.
— pluristriata.
— lineata.
Orthonata undulata.
— carinata.
Nuculites lamellosa.
— emarginata.
— triqueter.
— oblongata.
— rostellata.
— radiata.
— appressa.
— alta.
— multilineata.

Avicula flabella.
— parilis.
— perobliqua.
— angustirostra.
— subquadrans.
— boydii.
— erecta.
— æsopus.
— trilobata.
— pleuroptera.
— subfalcata.
— quadrula.
Microdon bellastriata.
Cypricardites elongatus.
— recta.
— mytiloides.
— alta.
— oblonga.
— rugosa.
— radiata.
— subulata.
— indenta.
— truncata.

Cypricardites concentrica.
— subtenta.
— corrugata.
— sectifrons.
— recurva.
Pleurotomaria capillaria.
— sulcomarginata.
Conularia undulata.

Pleurorhynchus crassifrons.
Inoceramus oviformis.
Pterinea radiens.
Goniatites uniangularis.
— punctatum.
Bellerophon brevilineatus.
Posidonia ? alveata.
— ? arcuata.

Crinoidea.

Nucleocrinus hallii.

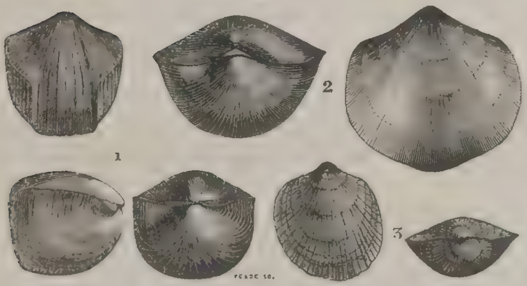
Crustacea.

Dipleura dekayi.
Cryphæus calliteles.

Cryphæus greenii.
— boothii.

## 23. TULLY LIMESTONE.

41.



No. 1. Cuboidal atrypa (A. cuboides). No. 2. Tully orthis (O. tulliensis).
No. 3. Lentiform atrypa (A. lentiformis).

This limestone takes its name from the village of Tully, near which it is quarried and burnt for lime. It is of importance, being the most southern mass of limestone in the State, and as a dividing line easy to find in all the counties where it exists, separating two important divisions of rocks. It is an impure limestone, fine grained, usually a dark or blackish blue, often brownish. The mass is more or less accretionary, breaking into irregular fragments which are usually small, owing to the particles of carbonate of lime separating from a mixt mass at innumerable points. The usual thickness is about fourteen feet; the greatest observed thickness, twenty feet.

It has not been seen beyond the town of Smyrna in an east direction; but from thence west it extends into the fourth district, through Madison, Onondaga and Cayuga. Its localities are numerous in the last two counties; but it was not seen in Madison, though it must exist there. The Tully limestone makes a good, but not a white lime; owing, in all probability, to the presence of carbonates of iron and manganese. These two minerals, as high up as the coal deposit, appear to increase from the Hamilton group, as the age of the rock diminishes. Minute veins of carbonate of iron are seen in the limestone; and the fossils of the rocks above it are often replaced by the two carbonates, particularly the encrinital stems and disks.

There are two fossils in this rock which are wholly peculiar to it. The first is the *Cuboidal atrypa*, No. 1 of the wood-cut. This is an English name, given to a fossil by Mr. Phillips, which, from the figure and description conjoined, shows identity with that of the Tully limestone. It is placed in the Devonian system, which gives but a feeble light as to the geological identity of the strata in which they are found. The precise position which the *cuboides* holds in New-York, will soon determine the position of its kindred one in England. The cuboides is found in most of the localities of this rock.

No. 2. The *Tully orthis* is the other fossil: It appears also to be an English one, from Mr. Conrad's information, having been described years ago by Martin, under the name of *Anomia resupinata;* but the former name is preferred, being a sure one.

No. 3. The *Lentiform atrypa* (A. lentiformis), from its shape like a lentil or lens, has always been considered by Mr. Conrad as the young of the A. prisca. It may be so; but its size is remarkably uniform, both in this rock, and in the corniferous and others. Its numbers are great, and show no intermediate sizes, and none of the larger kind are found in the Tully limestone; all which facts indicate a shell that had attained its growth, rather than a growing one. It is figured in order to draw attention to it, and from its constant association with Nos. 1 and 2.

There are other fossils in this rock, but they are rare, with the exception of a very small orthis at Smith's ledge, and a Strophomena resembling the *linear*, which occurs in great abundance in the upper part of the limestone at Tully four-corners. Among the others, are the Calymene marginalis, the Avicula reticulata, and the Atrypa didyma. Both of the latter are also European fossils, which I have not yet seen. By their means, Mr. Conrad believes that he has shown the identity of the Tully limestone with the Aymestry limestone of Mr. Murchison.

*Localities where observed.* The first point going west, is on the turnpike from Sherburne to De Ruyter, about eight miles from the former village. It appears in a low side-hill, forming the bank of the creek where the road crosses it. About four layers are exposed, ranging by the side of the creek. It is more impure there than farther west.

In Madison county it was not seen, but it must exist there, as it is found to the northwest of De Ruyter village, about two miles distant. It appears in the hill-side more than one hundred feet above the valley, and in two contiguous ravines separated by a road. The one to the north is quarried, and contains good solid stone. The hill faces the east. The Cuboidal atrypa is tolerably abundant, and affords good specimens. The shales of the Hamilton group are exposed below the limestone, and the Genesee slate above it.

The Tully limestone appears about six miles north of De Ruyter, on the west side of Delphi valley, nearly opposite Fox's tavern. It was formerly quarried and burnt for lime.

Farther west are Tinker's falls. The water flows over this rock, and falls about fifty feet, the rock projecting ten or fifteen feet beyond the shale beneath it. Its thickness is about twelve feet; the lower part is considerably intermixed with shale, the upper layers being a pretty good limestone: the usual fossils are present.

At Tully four-corners, the limestone is quarried at a short distance to the southwest of the village, forming a part of the low hill at the head of the valley. The quarry is open to the south, and the rock is about twelve feet in thickness, covered merely with a thin coat of alluvion. Beneath the limestone is the Moscow shale, or upper part of the Hamilton group, which is very rich in fossils, and, with the refuse limestone, is used for enclosures; but it is useless, as it separates into fragments by exposure to the weather. The hill is an insulated mass, showing the former action of water between the north and south valleys; only escaping total destruction, probably from holding a neutral position.

Mr. Willis Gaylord is of opinion that this ledge extends across the valley, and forms its bottom. A pond below, having been sounded by a pole, appeared to present a solid surface. This is likely to be correct; for the broad shallow valley which extends to Cortland, favors the existence of a solid resisting bottom which this limestone would give, and which its southern slope would greatly aid. The rocks on the top of the limestone, being of a soft and yielding nature, would be favorable to a wide excavation or broad valley such as exists.

To the northwest of Tully, and in Otisco, it appeared at several points. The nearest where it is quarried, is on the hill-side by the road which leads to Amber. It is there about twenty feet thick, and about fifty feet above the road. This is the point where the maximum thickness was observed.

Along the valley of Otisco, at the head of the lake, it may be seen on both sides. It is quarried on the east side at Smith's, being burnt for lime. It appears towards the top of the hill, about three hundred feet above the valley, showing its regular low dip to the south. The ledge is about fifteen feet thick, forming a narrow terrace capped with the Genesee slate, above which we find the lower part of its succeeding mass. The characters at Smith's ledge are as usual; fossils are not numerous, but such as occur in the rock, the Cuboid atrypa, Priscous atrypa, &c.

The most northern point at which the Tully limestone appears, is at Ross's hill in the northeast part of the town of Otisco, which is also the highest point of the town. It caps the hill, and more of its surface is there exposed than in any of its other localities. Its layers form four or five steps on the north side; and the shale, which is beneath, is exposed in a well at that end. From its vertical joints, no water is retained on its surface; and the soil which covers it is excellent wheat ground, the plant not being thrown out by freezing, in consequence of the dryness of the soil, owing to the goodness of its natural drainage. The dryness favoring also the action of the sun's rays, makes it a warm soil. These are the observations of Mr. W. Gaylord; and when the same accuracy is universally obtained, and the conditions of each plant known and complied with, agriculture will become, in popular language, the most certain of sciences.

On the east side of Skaneateles lake, the limestone is quarried on the lot of Mr. Hathaway, in a brook a short distance southwest of Borodino. It is about fourteen feet thick, and about one hundred and fifty feet above the lake. About three of its layers are thick; others thin, with shale.

It appears on the west side of the lake, nearly opposite to Borodino, and about a mile and a half from the lake; and again at Vanetten's mill to the southwest, on the road from Owasco village to Kelloggsville.

In the valley at the head of Owasco lake, it appears at Montville, just above the dam, extending under the mill and the village. The rock is here about one hundred feet above the lake; the water falls from over the rock into a gulf cut into the shales below, to a depth of seventy feet.

Further south it is again seen about a mile from Moravia, on Dry-fall creek. There the rock is about sixteen feet thick, divided into seven layers, the one next to the lowest being five feet thick. The water has cut through the limestone, and falls over the shale for about thirty feet. On the north side of the falls, the shale has been removed from under the limestone to a considerable extent, forming a deep recess, and exposing about one hundred feet of its lower surface.

In ascending to Stuart's corners from Moravia, the limestone appears in the hill-side west of the valley. It is of a lighter color than usual, and the Cuboidal atrypa appears to be abundant. This was the only locality where the rock was seen on the west side of Owasco lake and valley, being elsewhere covered by soil, etc.

Towards Cayuga lake, it is first seen going south from Aurora to Ludlowville, about a mile below the town line of Genoa. Also in a road near by, which goes east, a considerable surface is exposed, the upper rocks having been washed away, and but a partial covering of soil remaining upon the limestone.

Further south, the Tully limestone appears in all the ravines or gullies to near the line of Tompkins county, being one of the rocks over which the little brooks of these ravines fall. Not far from the line, it makes its appearance on the lake; where it is finely exposed for some miles along the shore; continuing, with some interruptions, to Bloom's lime-kiln, about half way between the mouth of Salmon creek and the head of the lake. Where first seen, it must be about forty feet above the lake, dipping to the south. Higher up the lake, between Bell's ferry and Goodwin's point, the lower surface of the limestone is within a foot of the lake. This is the point of apparent greatest depression; the rock rising from thence, and attaining a height of thirty-five feet at the Devil's den, and sixty feet at Ludlowville; whence it descends, and entirely disappears below the surface of the lake a few yards to the south of Bloom's lime-kiln.

In the Report of 1839, the facts here presented, namely, an elevation far above the lake north of the county line, a depression bringing the lower surface of the limestone within about a foot of the lake south of the line, then a rise of sixty feet, and subsequently a total disappearance of it, appeared to be the result of an enormous curving of the rock, and not, as it really is, an apparent curvature merely, caused by a change in the direction of the lake to the southeast, the dip of the rock being to the southwest. Where the lake changes its direction below the county line of Tompkins, is the point where the rock descends from the north and rises to the south ; and where it finally disappears, the lake returns to its usual or general direction. That such is the fact is certain, from the accordance between the phenomena and that of a plane surface whose edge corresponds with the outline of the lake along the range of the Tully limestone, when placed so as to accord with the dip and direction of that rock. Thus if the plane be placed upon the map, spread upon a table, and raised so as to be in contact with the map at the point which corresponds with Bloom's ferry, a dip to the southwest being given to it, the point of greatest depression will be north of Goodwin's point, and it will be raised at Ludlowville, and to the north also of the depression. The parallel of Ludlowville is four and a half miles east of Goodwin's point, near which the rock almost touches the lake, and Bloom's kiln is five and a half miles east of that point ; a difference fully sufficient to account for an apparent curvature, which the experiment also satisfactorily explains.

The Tully limestone exhibits the same characters along the lake, as further east. It is from eleven to sixteen feet thick ; color blackish blue and brown. One of the lower layers is generally thick ; the bottom layer is frequently five feet in thickness. It is owing to this circumstance, and the softness of the shale beneath, that wherever a fall exists, the shale has been washed away to some depth, leaving a chamber or cavern, the limestone forming the roof or ceiling, as at the falls at Ludlowville, King's gully, and probably the Devil's den likewise.

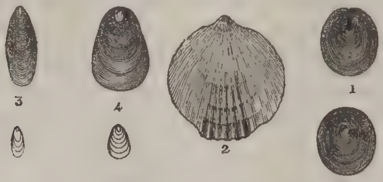
This limestone often shows an accretionary structure, and a rough notched appearance where its layers separate, as in some of the layers of the water-lime group ; also the fibrous appearance which belongs to epsom salts.

Blocks of this limestone are very common along the lake shore, where the ledge is seen ; requiring but to be encased with ice, the water of the lake raised, and then transported south and deposited, to account for the blocks of the same limestone which there exist and are burnt for lime, one of which is so large and so much buried as to appear to be in its original place, and was supposed to be the projecting part of a ledge of limestone rock. These transported blocks are found at various levels, to the south and east of Ithaca. In the latter direction, near the road which leads over to Dryden, in one of the transported blocks, the Calymene marginalis was found, which was described in the Report of 1839. The blocks which there occur are at the height of several hundred feet above the lake, and in every probability formed a part of the surface outcrop north of the line of the town of Genoa, and were transported south over the hills when submerged.

## 24. GENESEE SLATE.

*Black Shale and Slate, and Upper Black Slate of the Reports.*

42.



No. 1. Lodi orbicula (O. lodensis).
2. Four-ribbed orthis (O. quadracostata).
No. 3. Spatulate lingula (L. spatulata).
4. Concentric lingula (L. concentrica).

The Genesee slate is an argillaceous fissile mass, which with great propriety might be termed, according to English local geological phraseology, a *mud rock.* It is a thick rock towards Cayuga lake, rising upon the Tully limestone for about one hundred feet at its maximum. Its color is black, and very uniform ; and so is its structure, being more or less slaty, and somewhat hard and brittle ; but like all the upper fine-grained argillaceous rocks of the district, though its edges resist the weather, its surface, when exposed, falls into pieces, and readily decays. The joints in the rock are two in number, usually well defined, and their direction nearly at right angles to each other; thus, near Ludlowville, one is N. 8° W., and the other E. 12° N.

This rock contains but few fossils ; those only which are figured in the wood-cut having been seen in it in the district, with the exception of a well defined impression of a leaf about six inches long, broken at both ends, and a fifth of an inch wide, resembling a linear leaf of grass or sea-weed, the surface smooth. The fossils of the wood-cut were not generally diffused, but quite numerous in a few localities on Cayuga lake ; and the best localities for obtaining them are the ravines near Ogden's ferry, towards the upper part of the mass.

It contains a few septaria, well formed and characterized, appearing either in one or two ranges, far removed from each other ; the septaria in each range being also wide apart. The fissures or septa are often lined with lamellar sulphate of strontian, carbonate of lime, and a few quartz crystals. In one of the septaria from the ravine at Ogden's ferry on Cayuga lake, there was a liquid substance of the color of phosphate of iron or prussian blue, and another substance resembling spermaceti before the oil is fully pressed out. It was composed of small scales, hard and yellowish white, and was in small irregular formed masses of the size of a pea, with an appearance of having been melted. The blue liquid was entirely lost ; the white substance, though carefully packed up in the cavity of the specimen, disappeared, for nothing of it was found when unpacked. These same substances have been noticed by

Mr. Hall in the septaria of the same slate in the fourth district, and the discovery in the ravine at Ogden's ferry was made conjointly with him.

The Genesee slate was not distinctly recognized east of the town of Smyrna in Chenango county, probably owing to intermixture with sandstone, and its fossils not having been noticed. West of that town it may be seen in several points along the road from Smyrna to De Ruyter; and at the latter village also, which it underlies, and appears in all the side-hills around it. It is found near the dividing line of the counties of Cortland and Onondaga, forming the base of the hills, especially where the towns of Fabius, Truxton, Preble, and Tully join. It appears in many parts of those towns, and may readily be found by its black color, slaty fracture, and being between the Tully limestone and the sandstone flags of the base of the Ithaca group. Below Preble corners, where it forms the base of the abrupt hill which rises from the bottom of the valley, it is said from Indian tradition to contain coal, for which there is no other foundation than the resemblance which it bears to coal slate or shale.

The slate appears in the northern part of Spafford, upon the Tully limestone; on both sides of Otisco valley, at the head of the lake; near Vanetten's, in the northern part of Sempronius; along the side-hills of the valley at the head of Skaneateles lake; and in numerous places in Scipio, and along Cayuga lake to the west of the towns of Venice and Genoa, and on the west side of the town of Lansing.

In the ravines east of Ludlowville, the slate is well exposed from the Tully limestone upwards, presenting a mass which cannot be less than from eighty to one hundred feet in thickness. In the third ravine there are two high falls formed by this rock, which have some beauty, owing in part to the regular joints of the rocks being, as before mentioned, nearly at right angles to each other; the middle block having been removed, the edges and angles rounded, and the water falling in the direction of the joint. Near the Tully limestone, in the fissures of the slate, are two narrow veins of semi-crystalline rock of a blackish brown color, becoming olive by alteration. It appears to be a mixture chiefly of serpentine and limestone, having the appearance of a Trap rock. There are also two similar veins, near the foot of the second falls, in the same ravine. Both sets of veins traverse the creek at nearly right angles to its course.

The greatest exposition of the slate is along Cayuga lake, south of Ludlowville, along which it ranges above the Tully limestone, and below the Ithaca group, for a considerable distance. It often shows, where sheltered, a saline efflorescence of two or more different salts. The same was also noticed in Otisco valley, or depression south of the lake.

## PRELIMINARY OBSERVATIONS UPON THE UPPER PART OF THE ERIE DIVISION OF THE NEW-YORK SYSTEM.

The Erie division embraces the rocks above those of the Helderberg division, extending to the Catskill group. It presents through several counties on both sides of the boundary of the third and fourth districts, two well defined parts, separated by the Tully limestone and the Genesee slate; these latter are boundary masses of the two parts, being comparatively very thin, and of no great extent of range. The lower part of the division consists of the Marcellus shales and the Hamilton group; and the upper portion contains the different sandstones and shales below the rocks at Ithaca, subsequently to be mentioned, and the Ithaca and Chemung groups.

The distribution of the rocks of the upper part of the Erie division under the heads of Sherburne flags, Ithaca group, and Chemung group, was founded upon observations made with Mr. Hall, commencing along Cayuga lake, going south from Ludlowville by Ithaca, and from thence to the Pennsylvania line. The rocks, therefore, along that section, especially the upper ones, are the standard of reference, or type for those of their name.

The Genesee slate, which exhibits itself so prominently along the lake shore by its uniform black color and fine grain, and possesses all the characters of an ancient mud deposit of considerable tenuity, is succeeded by a series of layers of sandstone and shale, usually coarse; the sandstone layers being of unequal thickness, and some with smooth even surfaces, separated by more or less shale; the whole having the usual southwest dip, and disappearing near the head of the lake, under the succeeding or Ithaca group. These layers of sandstone and shale, being similar in mineral character to those near Sherburne in Chenango county, examined the first year of the survey; the same peculiar fucoid being found in both; and both holding the same relative position to the Hamilton group, though the intermediate rocks were not seen near Sherburne, were considered to be, as they are, the same mass, and the same name was consequently applied to both. Few or no fossils were observed in it at either locality, except the fucoids before mentioned; the position which it held, the absence of fossils, and the thickness of the mass not being less than one hundred and fifty feet, were the motives which led to its separation, or rather to consider it apart from the overlying rocks at Ithaca.

In such investigations, the mind is placed between two antagonist universal powers: a generalization or synthesis, the extreme of which destroys all individuality; and an individualization or analysis, whose extreme equally annihilates all generality: and consequently science cannot exist where either power is in excess, but arises from their mutual equipoise, being the middle term, the harmonizing principle, and performing the same useful office in what are termed the higher mental operations, that common sense discharges in ordinary life.

In commencing investigations of any kind, where the objects are numerous, lines must occasionally be drawn; they are to the mind, like the steps or rounds of a ladder: we have then a place to stand and look around, and to ascertain fully our position. From a motive of the kind, in part, Ithaca was considered a good point for the rocks below those of its immediate locality, now called the *Portage group*, and for the rocks above the Chemung group; the latter underlying the Old redsandstone or Catskill group, upon which the Coal group or formation rests, in all the middle and eastern portions of its range in Pennsylvania.

The rocks at Ithaca presented a different mineral appearance from those below, and from those above them; being darker colored, and the shaly part coarse, harsh, dull, and less disposed to be in layers than either of them; containing numerous fossils, which were wanting in the flags, etc. below; whilst those of the lower part of the mass at Ithaca appeared to be different from those of the Chemung group, the latter also containing fossils which were not found at Ithaca; for example, the very common Avicula pectenoides, which will be figured in the Report of the Fourth district, and the Avicula triradiata, figured at the head of that group in this Report.

Few places offer more powerful attractions to the naturalist, than Ithaca. The village is seated at the head of a lake, which is encircled apparently on all its other sides by a wall of rock, rising from the water's edge to a height of several hundred feet. The rock is favorably exposed in Fall creek, Cascadilla, and other water courses, which flow over its sides; and also at the inclined plane south of the village, where the products of the group, both fossil and mineral, can be examined to the greatest advantage.

In commencing this report, it was the intention of the writer to unite the Sherburne and the Ithaca masses, not having discovered in the district those leading characters by which they could be readily distinguished. They may, however, exist there; but finding, on the contrary, that Mr. Hall was desirous to unite the Ithaca and the Chemung groups, from the little or no difference which he could perceive between them in his district, and that the lower masses merited a distinct name, the original arrangement was retained, and the name of Sherburne was changed to Portage or Nunda group; not having the facts required to make any other disposition of them at present, as the specimens of the two districts were not arranged for satisfactory examination at the time of writing this Report. It is very certain that the old arrangement is inconvenient for both districts, but it is the only one which can be made previous to the investigation of their fossils. The question, no doubt will be settled in the Report on the Palæontology of the State. In the geological map of the State, the three groups, or upper part of the Erie division, are united together by the small scale of the map, and are colored of a light burnt umber. As they are thus arranged, they appear to correspond with the Devonian system of Mr. Phillips, the Ordinance Geological Surveyor of England, who separates the Old redsandstone or Catskill group from this system.

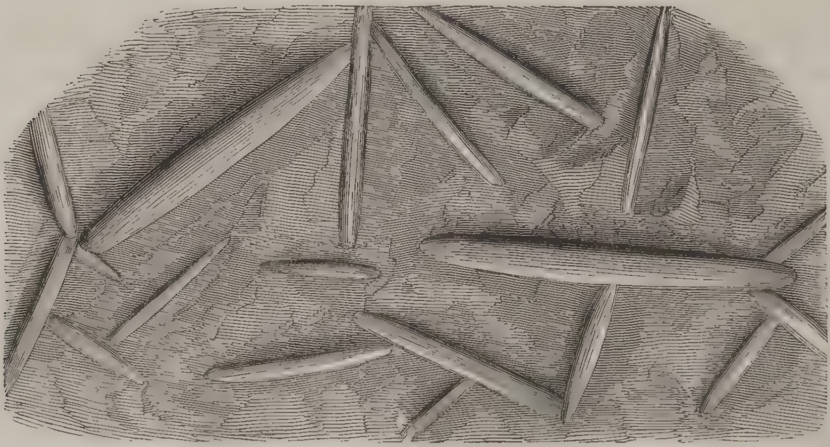
There are difficulties in the beginning of most if not all subjects; those in the three groups under consideration, arise from the little difference in their mineral characters, which for distant points cannot be relied upon. The change too in the fossil character is not so marked as to be at this time available, from the very imperfect manner in which as yet they have been investigated; more especially at certain points to be noticed, where one or more groups have thinned out at the east end of the district, and disappeared, bringing those of very different levels near to each other. A remarkable instance of this was given when treating of the Hudson river group; a fact which should be borne in mind in all investigations of fossils, where superposition is in question. What has caused Geology to advance with rapid strides, has been a knowledge of fossils; and when those of the upper part of the Erie division shall have been fully examined, and the kind determined which are limited to a group, and those which are not, then the difficulties will be at an end.

The course which appears best, and will be followed, is to give a cursory account, under their respective heads, of each of these three groups, as they appear along the common boundary of the third and fourth districts, and of other localities when well determined; and then to treat of them as they are connected together upon the map, as the upper part of the Erie division, as contradistinguished from the Marcellus shales and Hamilton group, which form the lower part of the same division.

## 25. PORTAGE OR NUNDA GROUP.

*Cashaqua Shale, Gardeau and Portage Groups, and Sherburne Flagstone and Shale of the Reports.*

43.



Graphic fucoid, (F. graphica.)

This group, which embraces the above mentioned masses of the Reports, may be considered as the commencement of the upper part of the Erie division, considering the Tully limestone and Genesee slate as dividing masses; the Tully limestone, however, properly forming the terminal portions of the lower part of the division, and the slate of the intervening one.

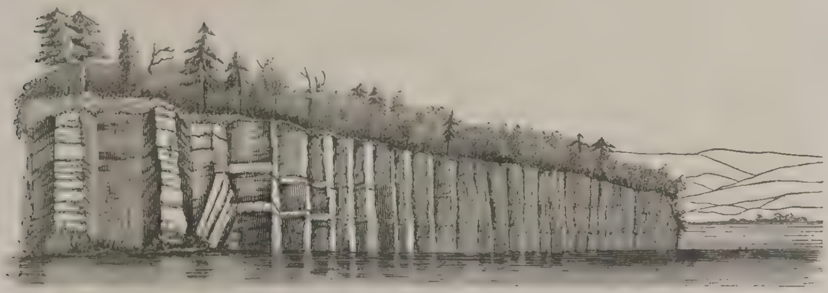
From the information already given of this group, little more need be said, especially as it is so greatly developed in the fourth district, and comes more appropriately under the head of Ithaca group.

As before said, its relative position is perfectly seen on Cayuga lake, and its general characters ascertained. The lowest layer on the lake is a sandstone, which the eye readily follows south as it dips towards the water, resting immediately upon the Genesee slate. This layer varies in thickness, in some parts being over a yard, and it is very compact and solid. The under surface presents great numbers of those peculiar bodies, or fucoids, so common upon the flagstones of the pavements of Ithaca, Homer, &c. They rise in relief upon the surface, with their ends generally depressed, and are usually from one to two or more inches in length; their form somewhat quadrangular; surface curved; existing separately, or variously grouped together and penetrating each other; resembling the stiff simple markings, excepting as to size, of the juvenile scholar. These bodies are not confined to this rock, but are found as high as the top of the Inclined plane, but were rarely seen in a higher position in the series, or even in a lower one. As yet the real nature of these bodies is doubtful, and they are therefore classed with Fucoids. The wood-cut at the head of this group will give some idea of them; but upon so small a scale, they are not so characteristic as upon a large one.

Beside these fucoidal bodies, there are others upon the surface of the sandstone, throughout the height of the group, which for the first time appear in the New-York system, but which extend into the upper groups. They have the appearance of narrow-leaf grasses, broken into fragments, and are invariably of a brownish black color.

There is less of the hard sandstone layers on Cayuga lake than at Sherburne, the hard coarse shale predominating west.

41.



View of Buttress cliff, north of South point on Cayuga lake. From a Drawing by R. C. TAYLOR.

Along the lake shore from near South point, extending north for about two miles, the rocks are of this kind, and form a highly picturesque cliff; their parts projecting in bold relief, caused by well defined and regular vertical joints in two and often in three directions, resembling a series of buttresses, only vertical in position, and therefore more properly pilasters, and giving a good idea of cyclopean masonry. The view given in wood-cut 44 was taken at that cliff.

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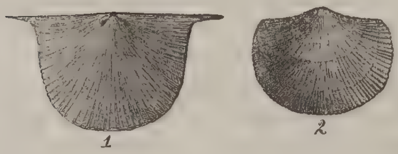
## 26. ITHACA GROUP.

45.



No. 1. Interstriate strophomena (S. interstrialis). No. 2. Ithaca strophomena (S. ithacensis).

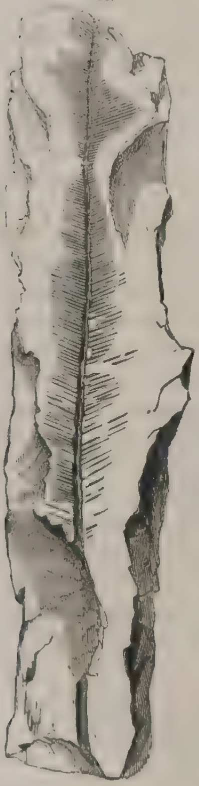
The rocks of this group are well exposed on Fall creek, on the Cascadilla, and in the other water courses further south ; also in the quarries, and by the sides of the Inclined plane, where considerable excavation was made, as well as in other points on the west side of that highly interesting boundary of the district. They consist of a series of coarse hard shales and sandstone, the whole generally of a dark color, and without any observed definite arrangement of the sandstone and shale. A few of the layers of sandstone are regular in their outline or form, and resemble some of those which belong to the group below, as may be seen in the wall of rock at Fall creek ; but this regularity of outline is rare, and no mineral character was observed by which the group could be recognized, even at no very remote points from the line of that section.

The wall of rock at Ithaca cannot be less than about four hundred feet thick. It is a mass, as before said, of hard and coarse shale and sandstone, dark in color, often brown after exposure, owing probably to manganese. The particular order and kinds of mineral products were noted at the Inclined plane, etc., but were too indefinite, and are therefore not given. The part which is principally quarried near the village, as may be seen at McCormick's quarry, is a hard and tough sandstone in irregular layers of a dark brown color when unaltered. The same mass may also be seen at the excavation of the inclined plane, and on Fall creek at the tunnel. The vertical joints in the rock in many parts are well exhibited, as for instance in the wall of the same creek, on the east side above the falls. The joints are in two directions, and nearly coincident with the cardinal points ; being a few degrees to the east of north for one set, and about the same to the south of east for the other. The joints on the north side of the creek have given origin to a series of gigantic pilasters, resembling in a measure those on the lake, given in the wood-cut of the preceding group.

The rock at Ithaca contains numerous fossils, but they are not so well preserved as those further south in the Chemung group. Among such as were thought to be characteristic is the *Interstriate strophomena*, No. 1 of wood-cut 45, the same in all respects with the Leptæna interstrialis of Mr. Phillips. This fossil, according to Conrad and Hall, is also found at the Chemung narrows, etc. It is abundant about half way up the inclined plane at Ithaca, and is found at Scott's corners near the head of Skaneateles lake, and in the quarries north of Homer. At these latter places, it is but little remote vertically from the Genesee slate. It therefore descends low, and has a wide range.

No. 2. *Ithaca strophomena* (S. ithacensis), is also from the inclined plane, but it is not abundant, and not much is known about it.

46.



The fossils which will show this mass to be a distinct one, should it be such, will be found towards the lower part of the inclined plane; for, without question, those higher up are found in the Chemung group. Among these latter we find the Atrypa squamosa, an Atrypa resembling the prisca, and the two valves which Mr. Conrad supposes to be the Strophomena membranacea of Phillips; the three considered to be Devonian fossils. The last is figured in wood-cut 48, at the head of the succeeding group. In the lower part of the mass at Ithaca are three or four species of cypricardites, an involute shell which appears to resemble the genus Clymenia of Phillips, three or four atrypæ, etc.

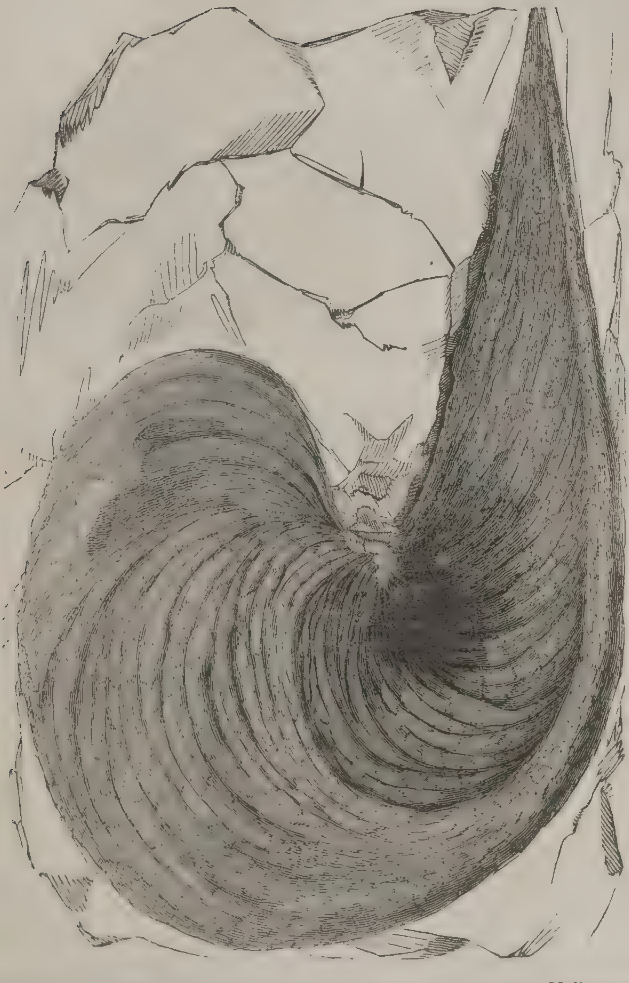
At the inclined plane, and at the rock of the tunnel, a very singular branching fossil was found, which at first glance might be supposed to be a Fern, but may prove to be an intermediate to the crinoids and corallines; Mr. Hall having discovered in his district some forms of crinoids, which are somewhat analogous to it. This fossil is exhibited in wood-cut 46. It consists of a stem, from which, on both sides, short and parallel rigid branches diverge with extreme regularity, far more so than belongs to any known plant, or crinoid, where the branches were movable; these being like the corallines in fixedness and regularity, probably it is intermediate to the two. The wood-cut was finished before it was known that Mr. Hall had obtained perfect specimens of the same from the tunnel. A fragment of a like fossil was also found on the west side of the lake, immediately under the Tully limestone.

Besides these fossils, there are others at Ithaca which resemble those which grow upon the surface of the earth, but they present very little character; showing no surface markings, varying greatly in size, their form being indeterminate, and the rock breaking too irregularly to admit of obtaining more than fragments of them. Some of these plants must have been over two feet in length, and two or three inches in width. They all show a conversion of their vegetable material to coal, but in few instances exceeding one-fifth of an inch in thickness. Similar plants are also found to the east of Ithaca, on the road to Dryden; at the quarries near Homer, where they are tolerably numerous; at Derby and Miller's quarry in the town of Truxton, and in many other localities. Fragments have occasionally been met with, showing that their form was spear-shaped or lanceolate. Specimens from all these localities are in the State Collection, and also a more interesting one from a quarry near Truxton corners. It somewhat resembles a reaping hook in shape, being falciform, about eight inches long, the surface covered with small deep and round punctations, not, however, well defined, owing to a defect in that part of the specimen.

With respect to the geographical distribution of this group, there did not appear to be much difficulty in tracing its boundaries upon the map through some of the counties east of Cayuga lake, when connecting it with the group below; commencing upon the top of the Genesee slate, and limiting the upper part to where the common fossils of the Chemung group appear. As no present advantage would be gained in noting the line of division, and as the whole are also connected together on the map, a few localities only will be noticed of this lower part of the Erie division, and with reference mainly to the Cauda-galli fucoids, this being the third position of these highly curious fossils in the New-York system. They are here well defined, and more extraordinary in shape than in their lower positions.

There are two localities where these fucoids were found to be quite numerous, and extremely well preserved. The first going east from Cayuga lake, is to the southeast of De Ruyter village, at Burdick's quarry on the hill, near the foot of which the Genesee slate is seen, covering the valley. The fucoids are met with over a considerable extent of surface around the quarry, and along the road towards Smyrna. The greater number are of the kind which have been compared by Dr. Locke of Ohio, to the folds of a curtain; he also having found them in that State, in the Waverly sandstone. An appropriate name would be *Fucoides velum*, or *Curtain fucoid*, as was, I believe, suggested by him. The figure given below in wood-cut 47 is altogether of a different kind, as is evident from its shape. It is from the same quarry; and in its form, it resembles a chemical retort. The specimen shows something like three systems of confluent raised surfaces, composed of rounded ridges, proceeding in curved lines from a point which is raised, as if they had been projected from a common centre, the three systems having united together, and terminating no doubt in a point which was broken off. These fossil bodies are difficult to represent without some practice, for which there was not time, wishing to complete the Report by a specified period.

47.



Representation of the *Retort fucoid*, from Burdick's quarry in the town of De Ruyter, Madison county.

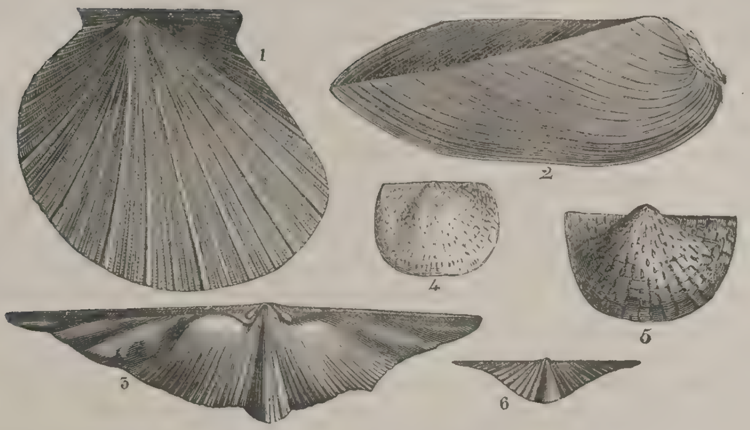
The stone of which the large academy at the village of De Ruyter is built, was obtained from Burdick's quarry. It is a grey sandstone, associated with bluish slate and shale, as usual with these upper rocks.

The second good locality is Harris' quarry, near the top of the hill to the west of North-Norwich. The quarry was opened for the use of the Chenango canal. In the State Collection are a number of these fucoids, obtained from De Ruyter, and this quarry, and which will not fail to convince the most skeptical that the nature or origin of these singular productions was organic and vegetable.

It was the intention of the reporter, at the end of this group, as stated in the prefatory part of the Portage group, to have given some explanatory matters relative to the three groups which compose the upper part of the Erie division, as put together upon the geological map of the State; but as something of the kind will be required for all that part of the map which relates to the district, the whole will with more propriety appear together in the chapter upon the map.

## 27. CHEMUNG GROUP.

48.



No. 1. Tricostate avicula (A. tricostata). No. 3. Prolate delthyris (D. prolata).
2. Chemung cypricardite (C. chemungensis). 4. Membranaceous strophomena (S. membranacea).
No. 5. S. membranacea, upper valve?

Between the Ithaca and the Chemung group, no precise line of division was observed. A high ridge was seen rising above the inclined plane at Ithaca; the rocks to the south contained none of the brownish sandstone of the Ithaca group, and there were different fossils noticed in the two: upon these differences the Chemung group was founded. The best section of the district for examining the two groups, is from the head of Cayuga lake to Factoryville. At Chemung narrows, the evidence of difference appeared to be conclusive; so also in the counties of Tioga and Broome, where, probably with one exception in the latter county, no lower rocks than those of the Chemung group exist.

The Chemung group consists of sandstone and shales, more or less slaty, and mixtures in endless proportions of the two; the former furnishes good building stone and flagstones; the latter being often soft, decomposable masses, but in a less degree than the shale of the Hamilton group. The sandstone in no part of the group shows well defined layers, in which respect it resembles the lower ones. The layers are also indistinct, and incapable of being traced from place to place by any mineral character noticed. Nor has there been time to ascertain, as before mentioned, if their fossils followed a definite order, so usual with these bodies; a subject which requires time, and much patient investigation to determine in a mass of its thickness.

As a group, the sandstone is of a lighter color than the lower one, the greenish or olive color being more general, and the shale more disposed to assume the same color when altered. Concretions of a large size often appear in the shale and sandstone, the nucleus being more solid than the surrounding parts. Carbonate of iron often replaces its fossils, particularly its encrinites, which are usually about half an inch in diameter, and different from those of the Ithaca or any rock below it. Some of the sandstone masses are loaded with shells, the cement being limestone, making a more durable building stone; and some of the varieties make good fire-stones, from the mixture of shells; premising that a good fire-stone does not mean one which will not melt, but which will not crack or fall into pieces when heated in the fires of the asheries.

This group was only distinctly recognized in the counties of Tompkins, Tioga, Cortland, Chenango and Broome, and in none of the others. In Tompkins, it covers the towns of Danby and Caroline, a small portion of Ithaca, and the southeast part of Dryden; in Tioga, the whole of the county north of the Susquehannah, and a portion on the south border of the river; in Cortland, the southwest part of Virgil, and those parts of the towns of Marathon, Willet, Freetown and Cincinnatus which border on each other; in Chenango, the greater part of the town of Greene, and some portion further north and to the west of Genegansette river; in Broome, all to the north of the Susquehannah, and west of the town of Colesville, including the south border of the river, and portions along the river through Windsor and Colesville.

At the beginning of this group, it was mentioned that an exception existed as to the Chemung group being the lowest rock of Broome county. This exception exists at Port Crane on the Chenango canal, near the north line of the county. There rocks appear, having similar fossils to those of the lower rocks which are quarried around the village of Norwich, and those exposed in the sides of the brook to the west of the village of Oneonta. There are three fossils at these localities also, which are the same with those of the Hamilton group, the Posidonia lirata, Strophomena carinata and Atrypa plebeia; showing that localities existed which favored the continuance of certain species, long after their total destruction in others; a subject which requires thorough investigation, and without which the value of fossils as a character will not be as deservedly esteemed as they should. It may be well also to mention that there are two other fossils very generally distributed throughout the Chemung group, which are considered to be the same as the Linear and the Umbonated strophomenæ of the Hamilton group; but they have not been sufficiently examined to ascertain with certainty either identity or non-identity with them. These shells are small, and therefore more difficult to determine, and other objects have appeared to be more important and pressing.

Wood-cut 48 exhibits some of the fossils which belong to this group, and by which it may be distinguished from the others.

No. 1. The *Tricostate avicula* (A. tricostata), so named from its showing three distinct sizes of ribs. Its surface and form make it a handsome shell. There are several aviculæ in this group that have a general family resemblance; the most common and characteristic is the A. pecteniformis, which will be figured in Mr. Hall's report of this group. It is believed to be the same with one in the Devonian system, from which it received its name. The tricostata belongs also to the same family.

No. 2. *Chemung cypricardite.* This fossil was met with in several localities; the greatest number were at the small bridge on the road to Lisle from Binghamton.

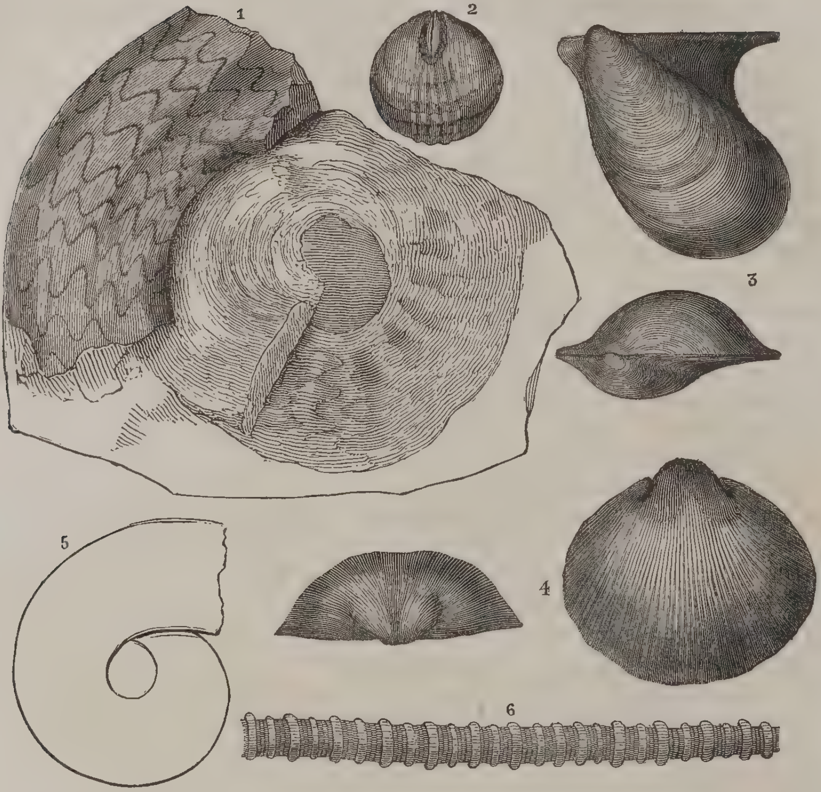
No. 3. *Prolate delthyris* (D. prolata). This is a very common shell of the group, and might at first sight be taken for the Mucronated strophomena of the Hamilton group; but the mesial part of the fossil is covered with fine ridges, and so also is the whole of the shell when perfect. It has also deep undulations upon the sides towards the extremities. The specimen was chosen from the State Collection, in consequence of showing a portion of the shell, and from the form of the internal part, and because it shows the structure of the hinge in part also.

No. 4. *Membranaceous strophomena* (S. membranacea). This is an exceedingly abundant fossil; few probably more so of those belonging to the group. It is believed to be the same with one which is figured by Mr. Phillips in the Devonian system, and is named in accordance with that belief. It is a spinous shell, the spines often visible in the matter of the rock. There are but two shells of the kind in the New-York system; the other is in the Hamilton group, and the differences between them are not ascertained.

No. 5. Supposed to be the upper valve of No. 4.

No. 6. ——— *delthyris*, not named, but very abundant.

49.



No. 1. Chemung goniatite (G. chemungensis ), imperfect.
2. Globuliform atrypa (A. globuliformis), a cast.
3. Chemung avicula (A. chemungensis), two views.
No. 4. Chemung atrypa (A. chemungensis), two views.
5. An imperfect convolute shell, which may be a Clymenia.
6. Tricircled encrinite (E. triciclas).

The Chemung group being so well characterized by its fossils, is the reason why so many are given in illustration of it. Some of those of wood-cut 49 are very common or numerous; others are rare, but believed to be confined to the group.

No. 1. The Chemung goniatite is rare; but being a large sized fossil, and only seen in this group, though it may not be a guide for the group elsewhere, it is a fact in its history.

No. 2. *Globuliform atrypa.* This cast is given, because it exists in myriads as such in this group, numerous localities abounding in it. It is well represented in the engraving.

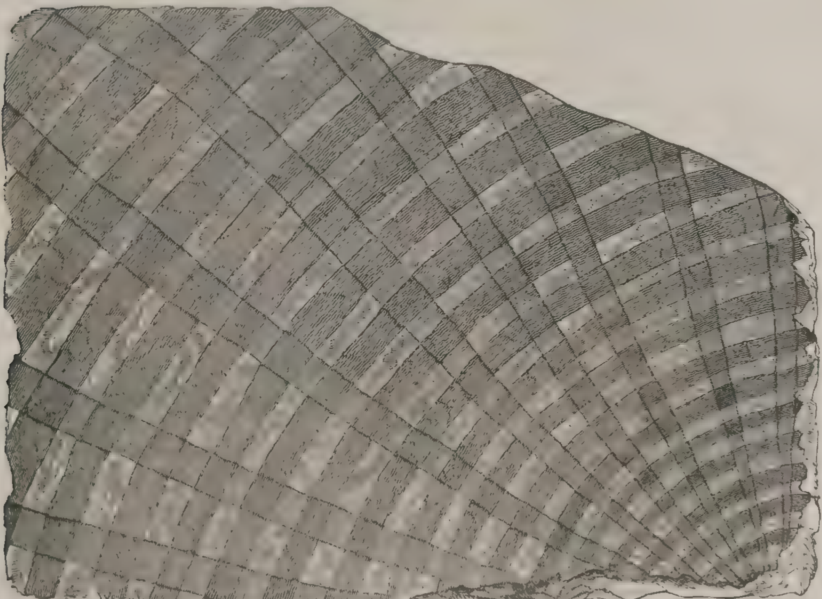
No. 3. *Chemung avicula.* This appears to be rather a common avicula, and is readily known by its well defined outline and its simple concentric markings.

No. 4. *Chemung atrypa.* This is the largest of all the species of Atrypa found in the district. The casts are given, as being more numerous than the shell, and therefore more likely to aid the observer in tracing or discovering the group.

No. 5. This convolute shell is quite imperfect, but is given to direct attention in search of better ones, and to discover those of the genus Clymenia, of which there are a number of species in England, belonging to the Devonian system. It is not unlikely that this may be one of the species of that genus.

No. 6. *Tricircled encrinite.* This name, it appears, was given to this species by the late Prof. Eaton. It consists of three different sized crinoid joints, grouped together, and is a very characteristic fossil of this group. It is found in many localities, such as the quarry at Greene, those near Binghamton, the creek near Factoryville, etc. It is usually replaced with lamellar carbonate of iron, colored yellow or buff. There are also one or more similar species in this group, none of which were observed to exist in lower ones.

50.

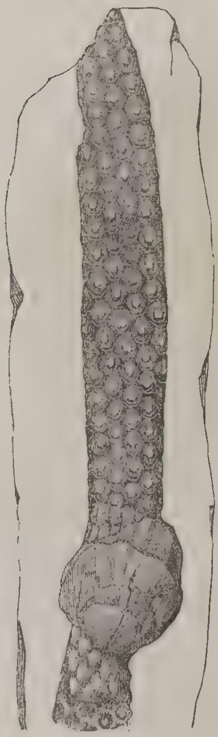


Chemung uphantenia (U. chemungensis).

The specimen, from which the very remarkable figure represented on wood-cut 50 was copied, is in the State Collection. It was found near the south end of the Ithaca and Owego railroad, by Mr. Leech, the former engineer of that road, who loaned it to the State, subject to his order. The wood-cut exhibits the whole length of the fossil, as it exists in the specimen. It consists of a series of broad rays, very thin, almost wholly superficial, which diverge from a common centre ; the breadth of rays enlarging for a certain distance from the point of departure, beyond which they are slightly variable. These rays are crossed by a second series, parallel to each other, the whole compressed together, resembling the geographic lines of a globe ; and were they lines and not surfaces, they would be perfectly comparative excepting for the distances between the two series. Having the appearance of woven tape, it has been named *Uphantenia*, from ὑφαντος, woven, and *tænia*, tape, and specifically *chemungensis*, after the rock in which it is found. The specimen is evidently not entire in any of its parts. When whole, it formed in all probability a large portion of a circle. Doubtless it was a marine plant, but wholly different from any thing which has come under notice. The engraving, though sufficiently accurate, is much inferior in effect to the original. The scale is the same, but some of the extreme parts were left out to suit the block.

There is another extraordinary fossil, as regards the position in which it is found. It belongs either to the lower part of this group, or the upper part of the Ithaca. It is sufficiently well preserved to show that the echinides are its associates. It is circular in form, measuring two inches and seven-tenths in diameter. Its five ambulacræ are very distinct and simple in their structure, consisting of two furrows quite near to each other, passing from the centre to the circumference ; on both sides of which are a series of short parallel lines or furrows, perpendicular to the former ones, the whole breadth of the ambulacræ being four-tenths of an inch. There appears to be the remains of two if not three others upon the same slab, which shows innumerable slender spines, about half an inch in length, strewed over parts of its surface. Should this fossil belong to the genus Echinus, its name will be *E. drydenensis*, or *Dryden echinus ;* having been brought from a quarry in the town of Dryden, with other stones, to Ithaca, and found by Mr. B. G. Ferris of that village, who loaned it to the State, subject to his order.

51.



The last fossil to be noticed in this group, is the one figured in wood-cut 51. It was found in Allen's quarry, near the village of Owego, by Mr. Car, an assistant of the survey. It was without doubt a terrene plant, in parts showing small portions of bark or surface being converted to coal. Its surface is quite peculiar ; the cast, as in the engraving, being covered with hexagonal forms like those of columnaria, but far more regular, showing a connection of structure between corallines and plants. The centres of the cells were depressed, one end rather more than the other, which appears as a protuberance in its mould. The surface of the part in the wood-cut, which represents the stem of the plant, is altogether imaginary, its structure being entirely obliterated, whereas the bed or matrix which surrounded it is well preserved.

The fossil which covers that part of the plant is a cast of a very common atrypa, left to show its entombed associates. It appears to be more nearly allied to Lepidodendron, than to any of the other classes of fossil plants.

There is a negative fact with respect to the third district which should be mentioned, and that is the total disappearance of all the trilobites; a fragment only of one was seen in this rock. From the period of the deposit of the Genesee slate, they began rapidly to disappear; only three or four fragments, to my knowledge, having been found in any rock supposed to be higher than the Tully limestone; one of which, the head of an Asaphus (the bufo), was found to the south of Ithaca at Bald hill; another near Norwich, and the tail of the Dipleura also at the latter locality.

The following list presents all the fossils belonging to the Chemung group, which have been identified and named by Mr. Conrad up to this time.

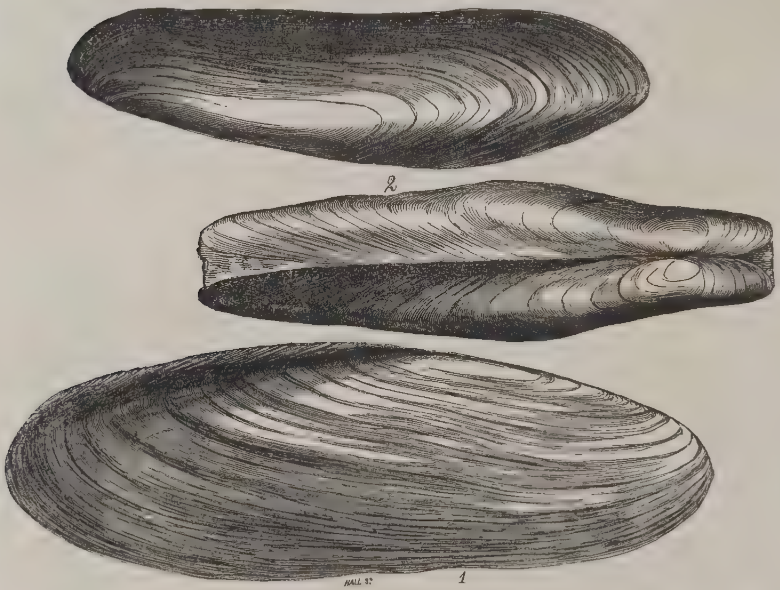
Delthyris chemungensis.
— prolata.
Strophomena mucronata.
— lachrymosa.
— lima.
— chemungensis.
— delthyris.
Avicula spinigera.
Avicula protexta.
— pectenoides.
— multilineata.
— chemungensis.
Cypricardites carinifera.
Inoceramus chemungensis.
Atrypa chemungensis.

## 28. CATSKILL GROUP.

*Montrose and Oneonta Sandstone of the Reports; Old Red Sandstone of England.*

(No. 9. Pennsylvania Survey.)

52.



No. 1. Catskill cypricardite (C. catskillensis). No. 2. Narrow cypricardite (C. angustata), two views.

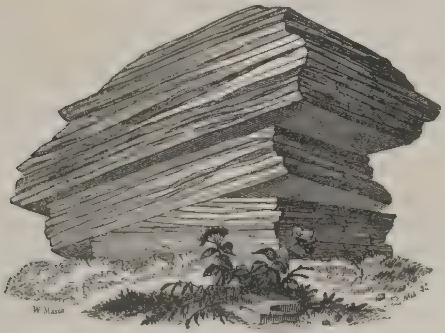
This group is confined entirely to the counties of Otsego, Chenango, Broome and Tioga. In the latter county, it is found only on the south side of the Susquehannah river. Being the terminal group of the New-York series, it therefore holds the highest position relatively to the other rocks, and caps some of the elevations of the four above named counties.

The group in the district consists of light-colored greenish grey sandstone, usually hard; of fine grained red sandstone, red shale or slate; of dark colored slate and shale; of grindstone grit; and a peculiar accretionary and fragmentary mass, appearing like fragments of hard slate, cemented by limestone. This mass, though usually but a few feet in thickness, where it is thickest in the district, is a constant associate of the group. It has not yet received a name with us, but is well known in England by the name of *cornstone;* and there also, from what we read, it is confined to this group.

The structure which the hard grey sandstone often presents, is also highly characteristic of it. It appears in many localities, generally forming the surface rock, usually in layers from four to ten feet thick, and nearly horizontal in position. Each of these layers is subdivided into numerous parts, from one to more inches thick, often disposed in oblique divisions; the surface of some straight, others bent; the divisions usually overlapping each other, showing considerable symmetry, presenting altogether a singular conformation, and a highly picturesque rock. Where this rock has not been exposed for a long time to the weather, the structure is not so obvious as in those masses which for ages have been subjected to it; the latter exhibiting it fully.

The cause of this peculiar angular arrangement is not yet satisfactorily determined. That it is not connected with stratification is obvious from the disposition of the whole or larger masses, being in horizontal layers, as they may be termed, so usual with those of the New-York system in the district. Among the many localities where this structure exists in the most marked manner, is one in the road from South Norwich to North New-Berlin, near Matherson's pond; one on the hill-side, near the top, below Oneonta; on the west side of the Chenango, above the village of Greene; on the Genegansette, above the same village, etc. etc.

53.



The above wood-cut will give a good idea of the appearance of this rock; the upper part showing all the regularity of a pile of boards, to which it has been compared, and the lower part the oblique lines of division which so commonly accompany it. The engraving is from a drawing made by Mr. Mason of Philadelphia, from the same group of rocks in Pennsylvania, and is given as a substitute, not having a specimen of our own; which is to be regretted, so finely is the peculiar structure of this rock exposed near Matherson's pond.

Between the Catskill and the Chemung groups, no line of demarkation was observed in either State. In ascending upwards from the Chemung group, the first signs of change which usually appeared was a diminution, then a disappearance of the fossils of the Chemung, a more solid or hard rock succeeding, often accompanied by red sandstone or red shale, and the grey sandstone sometimes accompanied by thin beds of cornstone, which readily attracts the eye, when long exposed to the weather, from its cellular appearance and dark umber color; the former caused by the removal of accretions, etc. of limestone, and the latter by the oxidation of iron and manganese associated with the calcareous material. Above all these, and usually capping the whole, was the complex structured sandstone, of which the wood-cut is intended to give some idea.

The fossils which have been observed in this group in this State so far, are but few in number, the group being very barren; and so also in Pennsylvania, where the rock has considerable surface distribution and great thickness. In this State, the only ones which with certainty could be referred to it, are the two shells figured at the head of the group, from Richmond's quarry, above Mount Upton on the Unadilla. The half probably of a third species was also found at this quarry, but no other fossils, except vegetable remains of the smoother sort, or rather the kind without marks or configurations, having simple lanceolate forms.

No. 1. *Catskill cypricardite* (C. catskillensis). This species is the most numerous, appearing to exist in great numbers at the quarry; besides its greater width, it is distinguished from the next species by the circle on the sides, curving at a higher point on the back.

No. 2. *Narrow cypricardite* (C. angustata), exhibiting the back and side. They have very much the appearance of fresh-water shells. They are considered by Mr. Conrad to belong to the genus named, but the generic character is wholly obscure. The circles with which the sides are marked as above mentioned, curve at a lower level than in those of the preceding species.

In this group, both in England and in Pennsylvania, are the remains of a peculiar class of fish, which show the value of the fossil character, since the position of the rock is well established; holding the place of base to those of the coal in both countries; being above the Devonian system according to some geologists, or forming its upper member according to others, just as it may be included in or excluded from that system. These remains have been found in many places in Pennsylvania, and some of them are described by Mr. Hall. As yet but small fragments only have been seen in this State. They exist in the cornstone near Oneonta, and in the same mass near Oxford, and no doubt will generally be found in that fragmentary portion. The small fragments in the cornstone show that besides containing accretions of limestone or carbonate of lime, it also contains those which have been subjected to a mechanical action, which has rounded some of its particles.

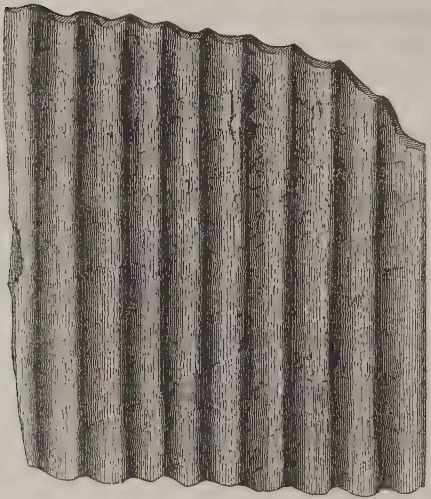
Though shells and bones are rare in this group, plants appear to be much more numerous; accumulations existing similar to those of the Ithaca and Chemung groups, but in greater number and frequency, and giving rise to thin seams of coal; none of which, however, exceeded a foot in length or breadth, and an inch in thickness; and they were generally found in the grey sandstone rock. These accumulations are rarely unaccompanied by pyrites, the decomposition of which stains the rock of an ochery color. The sandstone, coal and ochery appearance, being three of the common characters of the coal in its proper series, is the reason why the strongest hopes have been entertained of finding coal where they exist, the great fact of position and more important associates of the coal beds not having been attended to. Instances are but too frequent where explorations for coal have been undertaken, which have been attended with much anxiety of mind, and have resulted in nothing better than a waste of time and loss of money.

The Catskill group is the immediate predecessor, and the base therefore of the Coal formation. On it the latter rests, when they coëxist in the same locality. This fact gives a high interest to the Catskill group, from the great importance of the coal, and the certainty that all of it is the product of vegetation, with the insignificant exceptions of animal origin; and every plant which preëxisted to that era is of importance also. Both were the precursors of one of the most extraordinary periods of the world's history, in which the surface of the earth was covered, as if by enchantment, with a luxuriant vegetation, and wholly of a peculiar Flora. During the continuance of that period, vast stores of coal were formed, the daily consumption of which now adds to man's production, and the increase of the arts; and with every advance of the latter, a proportionate advance of higher powers of the mind also takes place. To those who connect effects with their causes, every discovery of a plant in any rock which preceded those of the coal era is of interest, as adding a valuable fact towards the final solution of that remarkable era, an era like which none other existed either before or since. Entertaining this opinion, no opportunity was lost in adding to the number of facts known.

The coal was not the product of a transient period; for during its day the carboniferous limestone was formed, which in many countries, from its thickness and great extent, is an important member of it. It abounds in marine fossil shells, which are as characteristic of it as those of the Chemung, the Hamilton and the Trenton masses are of their respective rocks. Where this limestone does not exist, shells are extremely rare, which is the case with the whole of the rock associated with the Pennsylvania coal, upon its north and east border, showing in this respect, and which is also the fact in other countries, an accordance with the Catskill group; the conditions required for marine fossils having been but very partially complied with during the whole period that their materials were being deposited, with the exception of the carboniferous limestone before mentioned.

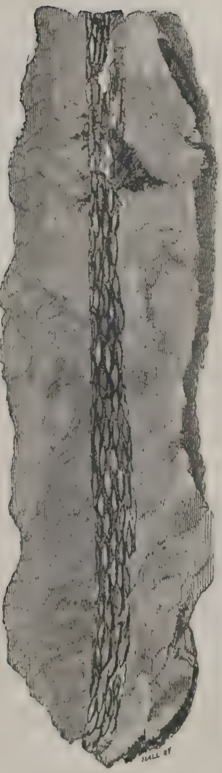
Besides the very common plants which have no determinate markings upon their surface, others have been found in this group, some of which are in the State Collection.

54.



The first, wood-cut No. 54, is from the group between Mount Upton and North-Bainbridge. It resembles a common coal plant, but differs in having no markings whatever on the raised surface between the fluted parts. It is a sigillaria, and if unknown, may be called *Plain sigillaria* (S. simplicitas). The specimen is in the State Collection.

55.



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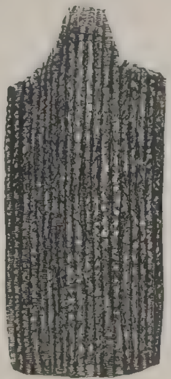

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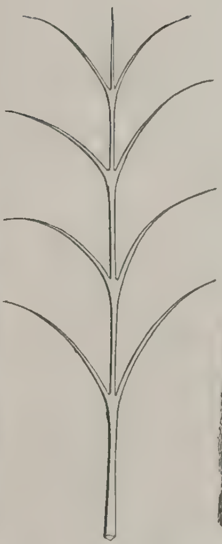
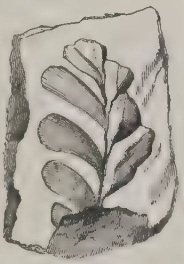


58.



Nos. 55 and 56 are also in the State Collection, and were found between Bainbridge and Colesville; they are of the natural size, both being fragments.

No. 55 resembles in structure the one given in the Hamilton group, the raised parts being larger, and more numerous upon the same extent of surface in this than in the other group.

No. 56 is covered with punctuations, semi-regularly disposed longitudinally, inducing a belief that its surface is slightly channelled. Both specimens are in the State Collection; the first is in sandstone with some shale, the latter with little or none.

There is another plant from this group, and from the same section of the State, in the Collection of the Albany Institute. The surface appears to consist of numerous raised diagonal lines or divisions crossing each other, dividing the surface in small lozenge-shaped forms and cavities. These, when examined by a microscope, show a series of alternate segments of lenses, which cause the lozenges wholly to disappear; the parts which separate them, when magnified, are detached; and when examined by the unaided eye, form the raised and apparently continuous straight diagonal lines. There was no time to give a wood-cut of this plant, but it will appear in the Report on the Fossils.

No. 57 of the wood-cut is reduced nearly two-thirds. It is an extremely regular and simply formed plant. It is from the same group; on sandstone, and was found near Silver lake in Susquehannah county, and formed a part of the Collection of the late Dr. Rose of that place.

No. 58 is from the same group and county, a few miles below Montrose. The form and markings of the leaves resemble some of those upon a very fine specimen in the Collection obtained by Mr. Hall from the Chemung group in the fourth district. The size natural.

Besides the plants which grew upon the surface of the earth, there are others which were the products of the ocean. These, the fucoids of geology, are often seen, and in the red shale rock particularly. They appear as stems, with smooth surfaces, usually more or less bent or contorted, and generally about the thickness of a pipe-stem. They are found in the other rocks of the group also, but they separate more readily from the shaly part of the mass. In Otsego county, they are quite numerous between Oneonta and the junction of the Susquehannah and the Unadilla.

### *Geographical Distribution of the Catskill Group in the District.*

In Otsego county, the group makes its first appearance on the Susquehannah a little below the village of Oneonta, and extends thence by the river to Chenango county, forming the surface rock of a large part of the town of Oneonta, nearly the whole of Huntersville and of Unadilla, and extending north for some miles between Butternut creek and Unadilla river.

Near Oneonta village, the greater part is a sandstone of a greenish color, in very thick layers, nearly flat, and these again composed of oblique divisions overlapping each other. The sandstone is quite micaceous; its parts thin like tiles and flags, containing here and there a few plants whose material is converted into coal. These rocks occupy the highest part of the face of the hill, the base of which is composed of rocks which I have supposed to belong to the Ithaca group. Occasionally a few thin interrupted beds of cornstone may be seen, in the finer varieties of the upper rocks.

Between Oneonta and the forks of the Unadilla, the red sandstone and the hard red slaty shale with fucoids, are seen in numerous places by the road-side, the soil and road being often colored by them. More of the rock is exposed in mass below the village of Unadilla, than in any like distance above the village. The red sandstone appears below Gilbertsville, and the soil, in parts, is colored red by its rocks.

The locality of most interest met with in Otsego county, is at Richmond's farm, at his stone quarry, about two miles above Mount Upton, facing the west, and rising about one hundred feet above the river. The lower part of the quarry is of the usual greenish grey sandstone, in irregular divisions, containing a few fragments of vegetable remains. The upper part is a greenish shale and sandstone, the latter occasionally showing an accretionary character. It is in this part of the quarry, that the large elongated bivalves figured at the head of the group were found. Higher up the hill the soil is red, concealing the rocks, some of which no doubt consist of red shale, so abundant on the Susquehannah to the east of the hill, and to which the soil owes its color. It has found its way to the rocks at the top of the quarry, staining, or rather soiling them red.

In Chenango county, the group extends from the county line of Broome, covering the surface of the towns of Bainbridge, Coventry, Guilford, and the greater part of Oxford, receding a few miles below Oxford village from the Chenango river; also from the Unadilla to the north of Guilford, diminishing in width between the two rivers, gradually diminishing in extending itself north, and terminating in the towns of Sherburne and Columbus. West of the Chenango, it appears about a mile or so to the north of the village of Greene, forming a part of the mass in the town of Oxford; and extends north on both sides of the Genegansette river, covering three-fourths of the town of Macdonough, the greater part of Preston, the southwest portion of Plymouth, and the larger south half of Pharsalia, its northern limit being in the latter town.

It is quarried on the west side of the Chenango river, north of the village of Greene; the rock being but a few feet above the road, showing thick blocks, subdivided into thin courses obliquely arranged; the rock is hard and unchangeable. On the east side is the quarry of McNeil, four miles south of Oxford village. It produces flags, stepstones, etc., some of which are sent to Binghamton.

The best stone for building and other purposes of the kind, in the county, is a grindstone grit of a yellowish color, which is found in many places in the towns of Preston, Smithville and Macdonough. It is easily wrought, hardens by exposure, and is used for grindstones, and for building: the court-house at Norwich was constructed of this stone, and there are several quarries of it opened in Preston. It is the upper rock of the group, and it is quarried to a considerable extent as a building material and for grindstones.

The group covers the largest portion of that part of the county of Broome which lies between the Chenango and the Susquehannah rivers, and that part south of the latter river which lies between the river and the Pennsylvania line, forming and covering all the highest points on the east and south sides of the county.

In Tioga county, it is found only on the south side of its great river, capping all the high hills, and extending itself into Pennsylvania, where it forms the greater part of the surface rock of several of the northeast counties.

On the geological map of the State, now being constructed, the Catskill group is colored of a dark red. It is placed as a group with four divisions, making the fifth member of the New York system. In the first chapter of this Report, it is distinctly mentioned that the system is purely geographic, and an all important one, being the only system which could be satisfactorily established at this time; for no territory of the same extent is known, where so unbroken and so perfect a succession exists, as in this State. The last remark to make on this group is this: It stands by itself, at the top or head of four divisions as a group, for this reason simply, that it has more relationship with the Coal deposit or group than with any of the groups below. It forms with the Coal and the New redsandstone, a natural and a triune division of a UNIVERSAL CLASSIFICATION, but which cannot be made without commencing and completing the geographic ones.

# CHAPTER VI.

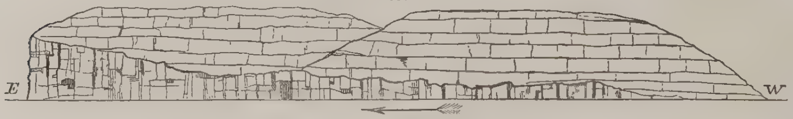
*Localities of the superposition of the different Rocks of the preceding Chapters, with the exception of some of the upper ones, illustrated by wood-cuts.*

The subject matter of this chapter — and especially its wood-cuts, which exhibit the actual superpositions, where best seen, of the different rocks and groups, with the above exceptions, which belong to the district — would have been of more advantage to the Report, had it been incorporated with the parts which it is intended to illustrate. This no doubt would have been done, had sufficient time been taken to mature the whole plan; but the desire to finish the work has been too strong, and knowing that if it first appeared, it would be followed by the three other parts or reports of the other districts, so that whatever was omitted would be supplied, and if a better arrangement could be pursued, it would be followed. It must be borne in mind that these reports are but the reports of districts, and not of the whole State; the object of which, as contemplated in the plan of the survey, was to furnish materials for a work of the kind; and therefore the same finish of character could hardly be expected of them, though, if given, it would greatly add to their value on their own account, and to their utility in the preparation of a Final Report for the whole State.

In the ascending order, the first systems as to superposition, are the Primary and Taconic, which will be dismissed in a few words. Properly speaking, there is no member of the Taconic system in the third district, but *partial* products only, as stated in the fourth chapter of this report, but misprinted *particular*. These are found on the northern slope of the Primary, and there only in this district, and have been fully spoken of under the head of the system, and will again be adverted to in the chapter on the counties, under the head of Lewis county. The Taconic system is but a nominal one in the district, though not so on the eastern border of the State. The next in order will be the New-York system, constituting the all important portion of the district.

The most satisfactory connection between the Primary and the New-York system, is best seen along the Mohawk, at the upraised hills of the gaps of the Noses and of Little falls, especially at the latter, for there the primary forms the base or surface rock of the whole of the gap through which the Mohawk flows, whilst at the Noses it appears only at the east end. The connection at either locality of these upraised masses, which show the two systems, is not with the lowest rock of the upper one, but with the Calciferous sandrock, the second member, which is finely displayed at both. No section is given of the Potsdam sandstone, as it occurs but in patches, and being an extensive rock in the second district, the omission will be well supplied by Dr. Emmons.

59.

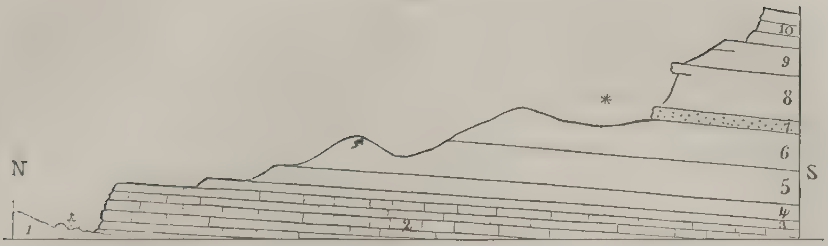


*Section of the Gap on the south side at Little-Falls; direction east and west.*

The above wood-cut, from a section on the south side of the village of Little-Falls, is a very fair representation of the junction of the two rocks, as they appear in the gap, from the east to the west end of it, the water having worn a passage of nearly a mile in length at this place, showing a perpendicular height of over two hundred feet for the calciferous sandrock on the south side opposite the village, at the west end of the gap, and about a hundred feet in elevation of primary rock at the east end.

These upraised hills or masses, which for brevity have been termed *uplifts*, show the greater number of the members of the Champlain division. Thus in going south from the village of Little-Falls, you ascend the cliff of Calciferous sandrock from the Primary rock; then pass in succession to the Birdseye limestone, the Trenton limestone, the Utica slate, and the Frankfort slate and its sandstone, the latter forming the lower part of the Hudson river group, extending south; being the surface rock of Fulmer valley, and the upper member of the Champlain division, and disappearing under the conglomerate, near Wicks' store in the town of Stark. The succeeding wood-cut (No. 60) exhibits the Champlain division as above given, the star marking Fulmer valley; on the south side of which, the Oneida conglomerate makes its appearance, being the third rock of the Ontario division, the two intermediate ones not existing at the east part of the district.

60.



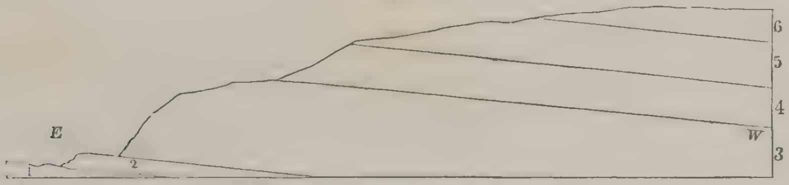
*Section from the south side of Little-Falls: Direction north and south.*

No. 1. Primary rock or system.
2. Calciferous sandrock, or group,
3. Birdseye limestone,
4. Trenton limestone,
5. Utica slate,
6. Hudson river group, lower part, } Champlain division, in part.
7. Oneida conglomerate,
8. Clinton group, } Ontario division, in part.
9. Onondaga salt group,
10. Water-lime group. } Helderberg division, in part.

* Fulmer valley.

From the absence of the upper part of the Hudson river group at the middle and east end of the Mohawk valley, the following wood-cut is given, which represents a section, passing west from Black river, terminating with the sandstone shale of Pulaski, being the upper part of the Hudson river group and Champlain division.

61.



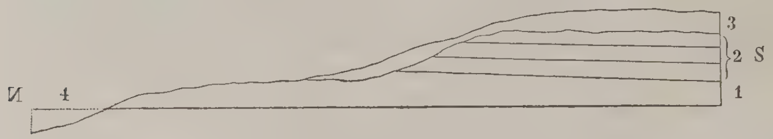
*Section west of Black river.*

No. 1. Primary rock.
2. Black river limestone.
3. Trenton limestone.
No. 4. Utica slate.
5. Frankfort slate, and
6. Sandstone shale of Pulaski, } Hudson river group.

The continuation of the section from Black river in a southwest direction, carries you over the surface of the Grey sandstone, which is well exhibited at the falls on the north bank of Salina river, and more finely at the great falls on the main river, where it is about one hundred and twenty feet in thickness. From the grey, the next rock in succession is the Medina or Red sandstone, which covers the greater portion on the south side of the west part of Oswego county. Then follows the Clinton group, which terminates the Ontario division, the Oneida conglomerate not having been seen in place in that county.

Between the different parts of the Ontario division, no striking point of superposition was noticed in that section of the district; the one of most interest, was the connection between the Grey and Medina sandstone on the west side of the river at the village of Oswego, where the two rocks show an interchange of each other's color. The Grey sandstone extends from the lake toward the dam, near which, at a higher level, the Medina sandstone is seen, the two rocks having a slight dip south.

62.



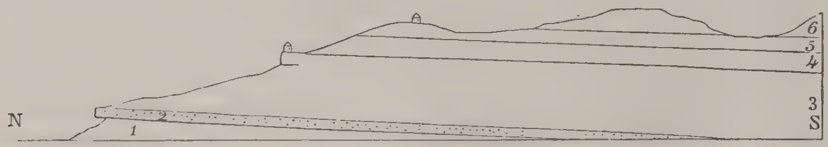
*Section near the mouth of Oswego river.*

No. 1. Grey sandstone. No. 2. Medina sandstone. No. 3. Alluvial. No. 4. Lake Ontario.

The only parts of the district where the Medina sandstone, the Oneida conglomerate, or the sandstone which represents this mass, and the Clinton group, are nearly in juxtaposition, is in Cayuga county. The best point for observation is at Bentley's quarry on the road from Martville to Hannibalville. There the Red sandstone and the Clinton group are within a few feet of each other, having a grey sandstone intervening, which is intermixed with the green shale of the Clinton group, presenting the same characters and the same position as the grey band of Rochester. The Medina sandstone forms the lower part of the quarry, and the two other masses the higher; the junction between the red and grey sandstone is concealed by drift, etc. No section was prepared of this quarry, by mere omission.

South of the Mohawk, through Herkimer county, etc., the hills and ravines afford fine sections of the connection between the masses from the conglomerate upwards, this rock through all that part resting upon the Frankfort slate.

63.



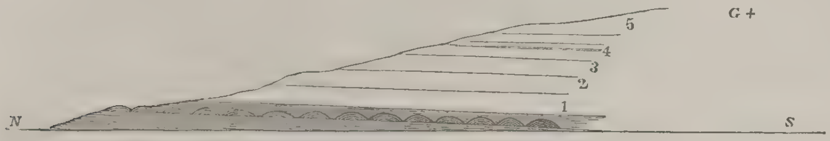
*Section north and south from Fulmer valley, by Fox hollow and Crugar's mill, etc., south in the towns of German-flatts and Warren.*

No. 1. Exhibits the Frankfort slate, etc., which forms the bottom of the valley
2. Oneida conglomerate.
3. Clinton group, with the grey sandstone mass at the top under the mill.
4. Red shale, and other masses which belong to the Onondaga salt group.
5. Water-lime group, quarried to the south of Mr. Crugar's.
6. Pentamerus limestone, forming the top of the two hills south of the quarrry on the road to Richford's springs.

The wood-cut No. 60, already noticed, showing the section to the south of Little-Falls, exhibits the same series as at Fox hollow, with the exception of the red shale, which is there wanting. The red shale makes its first appearance near Crugar's sawmill, and continues thence west through the district without interruption, and with increasing thickness.

As the Niagara group does not extend so far east, its position only could be indicated; coming in between the projecting part of Nos. 8 and 9 of the one section, and 3 and 4 of the other. It makes its appearance in the water courses further west, but is best exhibited at Hart's or Griffin's mill, on the road from Clinton village to Waterville.

64.



*Section at Hart's mill.*

The above wood-cut represents a section which appears on both sides of the creek at the south end of the mill.

No. 1 shows the concretionary masses which correspond to the Niagara limestone. It is enclosed in bluish slaty layers.

No. 2 is a bed of green shale, in all respects like the great mass of red shale, with the exception of color.

Nos. 3 and 5 are red shale; between which, at

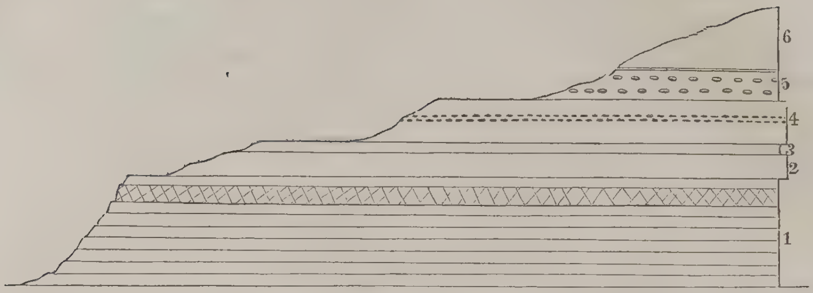
No. 4, there is green shale, and a thin layer of sandstone, from one and a half to three inches thick.

All the shales, etc. above the blue kind, belong to the Onondaga salt group, the base of the Helderberg division; the Niagara group being the upper member of the Ontario division.

The Oriskany valley in which Hart's mill is situated, consists of the rocks of the Clinton group, from Stebbins' creek north of Clinton village, to near the mill; the junction with the Niagara group being there concealed.

It was the intention of the reporter to have exhibited a section of Cherry-valley, showing the position of the Pentamerus limestone, the Catskill shaly limestone, the Cauda-galli grit, and other members of the Helderberg division, the character of the lower ones being so much better exhibited there than at Oneida creek, the next locality of superposition. The omission, however, is not much to be regretted; since the section on the west side of Schoharie creek, near the county village, in the first district, is at no great distance from Cherry-valley, where the same series, including the Oriskany sandstone, is well displayed; being one of the finest natural sections of the State, and admirable also for scenographic delineation. The advantage gained at Oneida creek, is the connection between the Helderberg and Erie divisions.

65.



*Section at the Falls of Oneida creek.*

The above section is taken at the creek from the falls upwards, before it changes its course from east to west on entering Oneida valley.

No. 1. The lowest mass is the Water-lime group, over which are the principal falls of the creek; the layer with diagonal divisions is the one burnt for lime; under it, is a layer of the water-limestone. The diagonal lines of the wood-cut are much too regular for a resemblance.

No. 2, consists of a few layers of the Pentamerus limestone, with probably some portions of the Catskill shaly limestone, but not well characterized.

No. 3. Onondaga limestone.

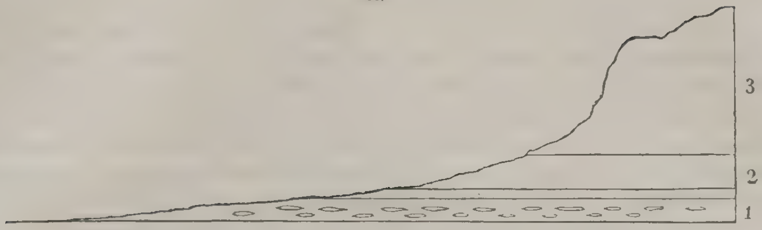
No. 4. The Corniferous limestone, with its parallel rows of flint; the part above the flint being well characterized Seneca limestone, and the Linear strophomena very abundant.

No. 5. Lower part of the Marcellus shales, with interrupted beds of dark impure limestone; the calcareous material in too great abundance to form septaria, and in too small quantity for regular layers. The upper part, marked by narrow lines, represents two layers of similar limestone, with goniatites and large orthoceræ, with here and there a little white lamellar carbonate of lime and some orange-colored carbonate of iron.

No. 6. The upper part of the Marcellus shales, the part which through Madison and Onondaga is of considerable thickness, and without fossils so far as was noticed. These shales form the surface mass for some extent in that section, but are covered with alluvion.

The best locality where the shales, and the Hamilton group, the next mass in succession, may be seen in immediate connection, is at Cherry-valley, in the brook which passes by the ashery southeast of the village. The water falls from the Hamilton group, passes over the shales, and upon the surface of the upper layer of the Corniferous limestone, the latter forming the bed of the brook near the ashery.

66.



*Section on the south side of the village of Cherry-Valley, in an east and west direction.*

The base line of the above wood-cut represents the surface of the corniferous limestone.

No. 1. The lower part of the Marcellus shales, with its interrupted beds of impure limestone and shale with fucoids, etc.

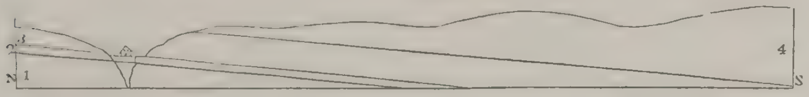
No. 2. The upper part of the same mass; no real line of division existing between it and the next one.

No. 3. The lower portions of the Hamilton group.

There are many other points along the long line of the Marcellus shales and the Hamilton group, where the two also may be seen passing the one into the other, but none so satisfactory as the one above given.

On the east side of Cayuga lake, there are many points where the junction of the Hamilton group with the Tully limestone, and of the latter rock with the Genesee shale, and the slate with the Portage group, are perfectly seen in juxtaposition, affording every evidence and facility necessary for geological sections. There being no time to prepare them for this report, and as the whole of this series exists on the west side of Cayuga lake, and with repetitions along the parallel lakes of the fourth district, the large and detailed sections omitted in this, and which are common to the third and fourth districts, will be supplied by Mr. Hall. The large section upon the map, however, shows the succession of the rocks in question, and to it the reader is referred. The section passes by the east side of Cayuga lake.

67.



*Section on Cayuga lake, north and south of Ludlowville.*

No. 1 of the above wood-cut represents the upper part of the Hamilton group, which exists near Ludlowville; the section passing along the lake in front of the village, the latter represented by a house in the gorge or valley.

No. 2. The Tully limestone, the village in part being placed near its level.

No. 3. Genesee slate.

No. 4. Portage group, or shales and flagstones of Sherburne.

Ludlowville is a highly favorable point for the examination of the masses 1, 2, 3, the village being placed in the centre of them; and were they grouped together, no name could designate them more appropriately than that of the village itself; and its interest is greatly increased by the undoubted fact that the two lower, if not all three, belong to the Ludlowville group of the British Silurian system, names which we would gladly adopt, were not those which we use, more accordant with the facts of the geology of this State, where the limits are better defined; and besides there is an absolute necessity for independence when investigating any subject not settled, or which is new, for the mind cannot attain to truth unless wholly untrammelled.

The Ithaca, Chemung and Catskill groups, having no precise lines of division between them, cannot so well be illustrated by such small engravings, and are therefore not given. They occupy large areas, and the sections on the map are referred to as substitutes for these smaller ones.

# CHAPTER VII.

## UPLIFTS OF THE MOHAWK, &c.

**The subject of this chapter formed a part of the Report of the second year of the survey: Its importance renders it necessary to give a considerable portion of what was then written.**

Along the borders of the Mohawk, extending through Montgomery, to the middle part of Herkimer county, there exists a series of parallel upraised masses or uplifts, extending but a short distance south of the river; the effects in that direction ceasing, the power which raised them being confined to the valley and the country north; the visible action having ceased before reaching that great massive, the southern boundary of the valley, which no local action of uplift has disturbed.

These uplifts or upraised masses consist of those rocks and groups whose position is below the Utica slate. They have been raised in place, just as if they were composed of a series of parallel blocks, under which a force was applied, which caused them to pierce the slate, and to appear at various heights in the district above the common level of the slate.

Northwardly, a few of the uplifts extend for some distance, but are finally lost in the mass of Primary rock, of which gneiss, the lowest member of the uplift, forms the greater part.

The general direction of the range of the uplifts is about north and south, as is evidenced in that of the Noses, and of the Little falls, the two most remarkable. The uplifts vary as to length, breadth and height. Some traverse the whole extent between the primary region and the river, whilst others are partial, occupying but limited areas. Whilst some have been raised so high as to exhibit the whole series of rocks from the Primary inclusive to the Utica slate, others show only the upper rocks of that series. In no instance has the order of arrangement in the uplifted rocks been changed, but each holds its relative position, appearing to have been gradually raised; and the Utica slate through which they were all thrust, though curved upwards at the point of contact with the uplifts, is unbroken, showing that the action must have taken place under water; the same results being exhibited by the upraised slate, which take place in the common experiment of cutting glass under water: as all vibration is prevented by the denser medium, those parts only are broken where the force is immediately applied.

With few exceptions, the whole of the uplifts have been produced by a power which raised the masses on the east side, giving them an inclination or dip to the west side; so that the eastern ends rise with a wall or mural face, whilst the western ones slope gradually, and are lost beneath the flat surface of the Utica slate, the line of continuity on that side being unbroken. Where the whole series is complete, the Utica slate forms the upper part of the uplift, and appears also by the side of the wall of rock at the east, curving from a flat surface upwards, and either reposing against the gneiss or a higher rock.

These uplifts have been thrust through the Utica slate, subsequent to the excavation of a valley scooped from that rock and the higher ones, the rock extending from the west of Utica into the first district.

The facts upon which this opinion is founded, are these: The direction of the hills to the south of the valley, which is also uninfluenced by the uplifts; the great breadth of the valley between the uplifts, and at the uplifts, especially on the east side of the gap at Little-Falls; the manner in which the high alluvial banks are disposed, which border the river valley; the composition of the alluvial, being uniform throughout the course of the river; and a correspondence in the height of the alluvial banks. There are other facts, but not so obvious as those mentioned.

Between Mindenville and the county line opposite Manheim village, there is proof that an ancient river bottom existed anterior to the one in which it now flows. For a mile or two in length and three-fourths in breadth, the surface is a plain, thickly covered with rolled stones disposed in all respects like those in a river bottom. They are of the usual kind, grey and red sandstone and primary rock, suitable for paving, and also of lesser size. The enclosures there are formed of them. The surface is like one of the same kind below the Noses, and another to the south of Herkimer village, the three being on the same side of the river. It is not easy to explain the cause of their existence, without the removal of the uplifted masses which form the barriers of the ancient valley.

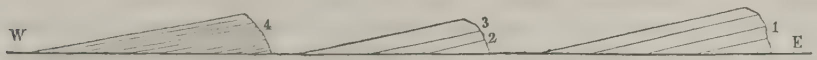
These uplifts of the Mohawk, from their limited extent—from no derangement accompanying them, other than is obviously intelligible—from their well-defined configuration—from being one of the terminal or extreme western limits of those great derangements whose cause has acted with so much violence along the whole of the Atlantic region of the United States, and from a number of highly interesting phenomena, are admirably calculated to instruct the student of geology in the knowledge of some of the causes of the varied appearance of the surface of the earth, and the derangement of its strata. At the junction of the uplifted rocks with the slate which forms the base of the valley, exudations of iron ore exist at several points, and in one instance a regular vein of lead ore, with a dyke interposed between it and the uplifted rocks. These are illustrations upon a small scale, of an action whose results are proportional, all things else being the same, to the magnitude of disturbance.

From the fact of the northern part of the uplifts being more raised than the south part, and from their inclination to the west, giving a southwest dip, it is obvious that the cause which raised the whole mass of the third district operated in the same direction with the one which produced the local uplifts; rendering it probable that the two effects were simultaneous, the result of a general and a partial action, as in the movements of an ocean.

These uplifts, though they have deranged the surface of the country where they exist, have in other respects been a benefit. It is obvious from the inspection of the geological map, that the Utica slate once covered their whole surface ; that by raising the lower rocks, the valley, and the country to the north of the valley, are abundantly furnished with limestone for lime, and with other excellent materials for building.

Along the Mohawk, the *first uplift* is that of Flint hill. The lowest part consists of the Calciferous group, which extends to Amsterdam village, and disappears under the Black-river and the Trenton limestone ; the whole of which, further west, are lost under the alluvion. This uplift has given rise to the quarry at Schelpintown, and to those of Amsterdam, Stanton's, &c.

68.



*Uplift at Tripes hill, by the side of the Railroad.*

The *second uplift* is at Tripes hill ; showing by the sides of the railroad, three elevations as in the wood-cut, the layers of which are inclined from east to west, ranging parallel with each other. The first rise, or No. 1, consists of the Calciferous group, a quarry being opened in this rock by the side of the road ; No. 2 consists of Birdseye limestone ; No. 3, the intermediate mass to that rock and the Trenton limestone, the two forming with the Chazy limestone the Black-river limestone group. The third elevation, or rise, No. 4, consists entirely of the Trenton limestone. They all dip west ten degrees south, and show the direction of their uplift, and the effects of denudation in producing their insulation. Between the Trenton limestone and the river, is the intermediate mass ; it is extensively quarried at this place, and on the hill near the village. The quarries near the village, the one at the foot of the hill in the fucoidal layers, and the large one on the hill, consisting as just mentioned of the intermediate limestone, are in parts of this uplift.

The *third uplift* is but very partial, the trenton only appearing ; it is by the road-side to the east of Caughnawaga, or Fonda.

The *fourth uplift* is the Noses. It rises in the valley like a huge dyke or mountain barrier ; showing a long continuous wall, (except where broken by the river,) which faces the east, and slopes gradually along the river to the west ; the Mohawk passing by a gap through the mass, showing on either side a cliff of the Calciferous group, which often rises vertically to two hundred and more feet. The gneiss forms the base of the east end. It shows itself in three places on the south side, and terminates its range east, rising probably one hundred feet above the river. On the north side, it underlies the road and extends to the side of the cliff, rising forty or fifty feet on the west of the brook, where the cliff appears to be divided into two masses. Gneiss also appears at the east end, where the rubbish, which partially covers its face, has been removed.

On the north side of the uplift, the calciferous has been uncovered to great extent, showing a surface averaging five miles in length from north to south. Further north, the primary takes its places, showing patches of Potsdam sandstone for about two miles from where it emerges from under the calciferous.

For some distance north of the river, at the east end of the uplift, alluvion and soil conceal the surface rock ; but beyond, at many points, as instanced on Richard Schuyler's farm, the Utica slate appears, dipping to the east at angles of about thirty degrees, the junction of the gneiss and slate being covered with soil. The higher the point where the slate was found, and the nearer its junction with the wall of gneiss, the more vertical was its position.

On the south side at the same end, blue clay appears in the road and bank of the river ; but further south, in ascending by the end of the uplift, the same slate appears, and inclining in the same manner, as on the opposite side of the river. At the south side, whether passing over the surface of the uplift at its extreme east end, or by the creek at Spraker's basin, or still further west, the Calciferous group, the Birdseye and the Trenton limestones, and Utica slate, all appear, the one rising upon the other in their order of succession.

The uplift of the Noses cannot be said to terminate along the river short of Palatine church, where the slate appears in the creek at its usual low level when not disturbed. The whole of the uplift is of a great interest, exposing a vast mass of rock, and the succession of the rocks, either going west along the river, or south. Many quarries are opened in its range, at Canajoharie, Palatine bridge, Fort-Plain, on both sides of the river, etc. The creek at Fort-Plain shows that the rocks on both sides have not the same elevation, those on the west side being higher than those on the east; therefore a partial uplift of the former exists, the two not being on the same plane, but forming what is termed a *fault*.

*Fifth uplift.* This extends from Palatine church to near East-Canada creek, exhibiting a large surface of the Calciferous group. It embraces two if not more series of uplifts, not having collected sufficient data to determine, though possibly the mere annunciation of the fact is at this time all that is required; the most difficult part of the task undertaken, being to know what ought, and what ought not to be reported, and the amount of detail to be given; the survey of the State having been divided between a mineralogist, four geologists and a palæontologist, and therefore involving repetitions which it might be desirable to avoid.

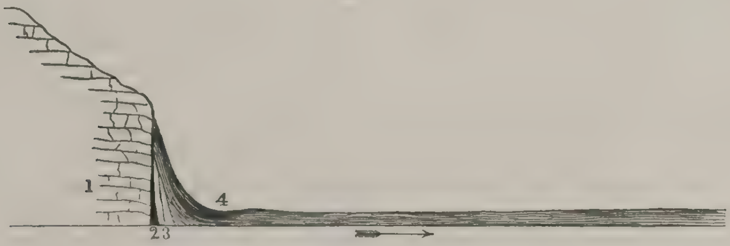
At St. Johnsville, there is considerable obscurity: the Calciferous group forms a high cliff in the rear of the village, extending from Crumb beyond Zimmerman's creek, in nearly an east and west direction. It is not the result of the wearing away of all the parts on its south side, so as to give passage to the river; for at the foot of the cliff, at Loomis' tannery, the birdseye is seen, but obscurely; next to it at the southeast, are the lower layers of the trenton inclining from the calciferous; and again to the east and north, the Utica slate—all within a few rods of each other. That these rocks are in place, is evident from the existence of the slate back of the village of St. Johnsville, above Averill's tannery at the little bridge. The slate there appears in the bottom of the creek, inclining from the calciferous, which rises one hundred feet above it: the slate dips to the south at an angle of about forty-five degrees. It shows much white carbonate of lime, and some pyrites. The calciferous, at its junction with the slate, is in one part fractured, the parts cemented forming a breccia. The slate is about eighty feet above the river. At a little lower level is the blue clay, in parts covered with earth and rolled stones.

The facts make it evident that the south end of the mass has also been raised, but not wholly, as the uplift appears on the south side of the river. Opposite to Lower St. Johnsville, and on the hill east of the quarry of birdseye limestone, the calciferous rises to the height of forty or fifty feet above a brook to the east, in the bottom of which is the Utica slate, with the Trenton limestone at a lower level. Thus far there is coincidence with the uplifts generally, but non-conformity and obscurity in the details, requiring more extended observations to make the whole intelligible. The slate and limestone in the brook dip with a curve to the northwest and west; the slate reäppearing again in the brook at the lower level, and at a higher angle. The range of the calciferous cliff was not ascertained, and the space between the rocks of the brook and the cliff was covered with soil. At the time of noting the facts, the required data were supposed to have been obtained, but prove to be insufficient.

About the half of a mile above Mindenville, the Utica slate reäppears near the river; its surface flat, showing the termination of the fifth uplift.

The *sixth uplift* is on East-Canada creek, and extends from the south side of the river at Manheim ferry, for a few miles above the falls. Though small, it is the most interesting, being the best defined.

69.



*Uplift on East-Canada creek, near Manheim bridge.*

No. 1. Calciferous group. No. 2. Dike and vein of lead ore. No. 3. Trenton limestone. No. 4. Utica slate.

The Calciferous group forms the left ascending bank, appearing like a low wall near the bridge; increasing in height up the creek; forming the falls; rising on the right bank to the height of fifty and more feet above the falls, and about thirty on its lower or southern side, the latter ranging about north twenty degrees east. The Utica slate forms, on the contrary, the right bank of the creek, appearing near the bridge on the same level with the calciferous; its layers equally flat, and continues in that position up the creek, until near the wall of the calciferous; there the layers gracefully curve upwards to the uplifted mass, as in the woodcut annexed.

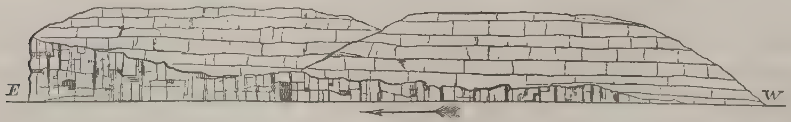
The slate at the uplift is not very thick, and shows in the creek and where upturned, two or more layers of the Trenton limestone (3) beneath it. At the junction of these rocks with the wall, a wedge-shaped mass (2) appears, enlarging downwards. Its color is of a dark green when fresh, but becomes earthy or yellowish by exposure. It has the characters and composition of an impure serpentine. It contains some crystals of mica of a third of an inch in diameter, which have been formed in the mass. Between this and the limestone and slate, is the vein of galena first noticed by Mr. Conrad. It is associated with blende and pyrites, and with white and brownish-black lamellar carbonate of lime.

The dyke, as before mentioned, and the vein, enlarge downwards. It was worked but for a few feet below the entrance, near the level of the creek, yielding no profitable amount of ore in the part excavated. The result is easy to predict, should the ore be derived from the visible upturned rocks, for the quantity would be small, not being of great thickness; but should the source be independent of these two rocks, proceeding, according to some, from something like the fountains of the great deep, the result is not so easily predicted. It is, however, one of those points theoretically of the highest interest. It is at the junction of dissimilar masses, hence electrical results could take place; where different exudations by the layers could unite, chemical action would result, and union with the former would produce galvanism: these conditions are requisite for the formation of metallic veins, and may here have all been realized. As matter of science, the investigation of this point is one of interest. It contains ore as a matter of fact. The bottom of the uplifts must extend to the point of fluidity; therefore ejections from that part may exist in the fissure, though it is more probable that it was filled up by lateral infiltration from the masses between which it exists.

Along the crest of the junction of the slate and the calciferous are some shallow openings, from which ochery ore, or hydrate of iron, was thrown out, which evidently was derived from the wall or calciferous group, such exudations being common from this group.

The calciferous, at the south end of the uplift, appears in the bed of the river. Higher up in the bank, near the ferry house, is the birdseye; above it, the Trenton limestone; the Utica slate forming the range in the rear of the river, and appearing in its usual flat or undisturbed position not only there, but in many points between the ferry and the east end of the uplift of Little-Falls.

69.



*Section of the Gap at Little-Falls, on the south side of the Mohawk.*

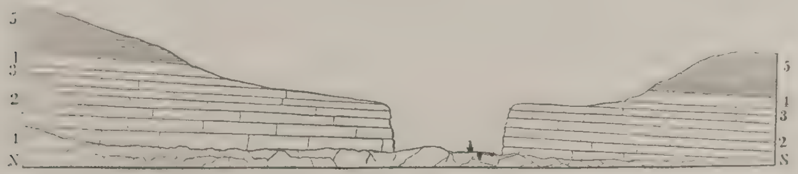
No. 1. Gneiss, the base rock of the uplift and the district.
No. 2. Calciferous sandrock.

The *seventh uplift* or series, is that of Little-Falls. It presents the same barrier-like appearance, at the east end, as the Noses, with no equivocal character as to origin at all observable; the valley at both extremities on both sides of the river presenting the slate in its integrity, with, however, a thick shield of alluvion on the north side, at the west or upper end. It is the only one which the river has not succeeded in cutting down to a level at both ends; probably owing to the great height as well as the breadth of the gneiss which forms its base, extending as it does from the east to the west end, and forming the bed of the river, over which the water falls. The uplift presents a wall on the east side, rising above the range of slate to some height on the north side of the river, and only broken where the river finds its passage. The gneiss rises at the east end to the height of a hundred feet, and disappears under the calciferous rock and the river at the west end. On the north side of the gap, its overlying rock, towards the east end, has been removed, presenting a terrace of many rods in breadth, and showing a greater breadth of river when at that height. On the south side the terrace is but a narrow one.

An interesting feature in the gap, as regards its antiquity and the progress of excavation, are the pot-holes in the primary rock. They are found at different elevations, some high above the present level of the river. They are numerous in the bed of the river, and occur between the river and the level of the aqueduct; at the railroad house; and in the wall of rock which rises above the road going east, after crossing the bridge. At this latter place, a section of one of them may be seen, extending from the top of the cliff to about fifteen feet below, looking like a niche for a statue, but reversed. These holes are obviously due to the rubbing or grinding of stones, put in motion by an oblique movement of waters, where rapids or falls exist.

The calciferous sandrock forms the whole mass which rises upon the primary on both sides of the Gap, extending north and south as in wood-cut No. 70. In part it rises vertically, showing a thickness of over two hundred feet: it is thicker at the west than at the east end. Its layers appear in the gap to be nearly horizontal, owing to the course of its excavation having been in the line of its bearing, the dip being about southwest. The fucoidal layers were not noticed, except at the old mill in the direction of its slope; they were but thin.

70.



*Section north and south, passing through Little-Falls.*

No. 1. Primary rock, gneiss.
2. Calciferous sandrock.
No. 3. Birdseye limestone.
4. Trenton limestone.
No. 5. Utica slate.

The above section exhibits the raised masses of rock which form the uplift of Little-Falls, exhibiting the same series on both sides of the river gap, being at right angles to the direction of the gap. In ascending the river, these rocks in succession appear at the level of the canal, and then disappear; no further trace thence being visible, with the exception of the Utica slate, which continues to form the base or bottom of the valley to the west of Utica.

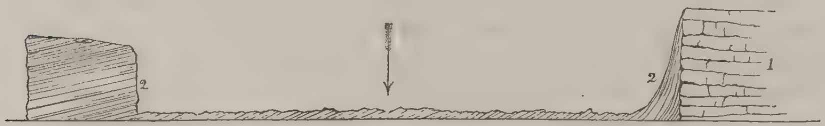
The slate is visible at the east end of the gap, on the north side, not far from the toll-house; it is there flat. It shows itself in several places, inclining from the primary and the calciferous, according to the distance from the junction of the two: the lowest angle observed was about thirty degrees.

The same observations were made on the south side, where the slate also appears in the small brooks which come from the uplift, and which show a high inclination from the uplift. Though obscure from rubbish and soil which have collected along the wall of the uplift, the disturbed position and inclination of the slate is sufficiently obvious; its usual position, when a little removed from the upraised masses, being flat or nearly horizontal. The upraised slate, as it exists on examination, at the east end of the uplift, would have been exhibited in the engraving were it not intended to give what was obvious without examination.

There are two other uplifts of a local character worthy of note, one on West and the other on East-Canada creek: that of West-Canada is at Middleville. It shows the whole series from the primary upwards. It is the last point to the west and north, where the primary is seen out of its range, or the calciferous appears to the west.

The primary rock is seen in the creek above the mill-dam at the village, and by the roadside on the left ascending bank. The calciferous forms a thick mass, appearing at a high level on both sides of the creek, and is followed by the birdseye and the Trenton limestone, and the slate.

71.



*Uplift on East-Canada creek, below Brocket's bridge.*

No. 1. Calciferous group. No. 2. Utica slate.

The uplift on East-Canada creek is of greater interest, being one of the finest displays of curvature from uplift yet seen or known to have been recorded. There no soil or rubbish obstructs the view of the whole length of the upraised slate, which extends in one broad unbroken sheet by the side of the creek for more than a quarter of a mile. Where it ends, going down the creek, the Trenton limestone appears from beneath, curving also in the same direction with the slate. This uplift is below the high falls, about a mile and a quarter below Brocket's bridge on the east bank of the creek. The rock of the falls is of slate, and so also is the west bank. Where the Trenton limestone appears from under the slate, is the point to commence ascending the creek, so that the upraised slate may be seen to the greatest advantage. The uplift consists of the calciferous, presenting its usual wall-like appearance, rising about seventy feet or more, and capped in part with the birdseye. In ascending the creek from the Trenton limestone, the Utica slate, with its thin layers or flags of interposed impure limestone, appear layer by layer, the curve and elevation gradually increasing from that point, and finally attaining the height of at least sixty feet; the slate, from the angle of the curve where highest, holding a vertical position.

# CHAPTER VIII.

## QUATERNARY DEPOSITS.

These, as mentioned in the table of contents, consist of two kinds or orders. The first embraces those which have been transported from a greater or less distance, as clay generally, sand, gravel, boulders, etc., and are commonly known by the name of *alluvial deposits*, or products of alluvion or alluvium. The second kind or order are the result of deposits in place from solution, as lake marl, calcareous tufa, ferruginous tufa; or of products of vegetation, as peat or muck. With respect to soil, it belongs to either, and should, from its importance, be made an order by itself. In this enumeration, the products of the decomposition of rocks in place, or, in other words, in the position they were originated, are not noticed, as not being of sufficient importance in the district, and as being included in soils.

### ALLUVIAL DEPOSITS.

The Mohawk river and its tributaries show a determinate order of alluvial deposits. So also there appears to be a like order through the great level, and no doubt the same prevails in the valleys south, but was not so generally noticed, but few excavations having been observed. The deposits of the three sections are not, however, in accordance with each other. Along the Mohawk river, and in many of its tributaries, the lowest deposit generally which was observed is a tenacious blue clay, similar to that of Albany, which becomes of a brownish color when long exposed; the top of the mass usually of that color, and less adhesive. In some places it shows alternations of sand more or less regularly disposed, the clay generally covered with sand more or less thick, upon which not unfrequently there is a third deposit, consisting of rolled stones, intermixed with loam; the stones consisting in greater part of primary rock, and red and grey sandstone, the two latter in greater number than the former. The deposits are so numerous, that those only of magnitude can be noticed.

They commence on the south side of the Mohawk, and continue by Port Jackson to near Auriesville. On the north side, the same deposit appears between Amsterdam and Tripes hill, and to the west of the hill. Its point of greatest magnitude is on the same side between Fonda and the east end of the uplift of the Noses, extending north by the side of the cliff, and rising from forty to sixty and eighty feet above the river. On the south side, the blue clay appears in the road, at the east end of the uplift, near the cliff. Further east, there is a level surface, rising about twenty feet above the river, showing numerous rolled stones resembling a river bottom. And again still further down the river, there is another river bottom over which the road passes, and is raised about sixty feet above the river; it is thickly strewed with river stones, and covered with a growth of pines.

West of Fort-Plain, on the same side, the deposit again commences, extending at intervals to near St. Johnsville ferry. On the north side, it reäppears on the west of that village, and with the exception of the interruption at East-Canada creek, continues to the uplift of Little-Falls. This deposit shows its threefold nature : blue clay, with alternations of sand ; then sand ; and finally, rolled stones, with loam chiefly.

Near the uplift of Little-Falls, on the south side, and at some distance from the river, there is an enormous accumulation of rolled stones, appearing as if they had been poured in torrents over from the west to the east side of the uplift.

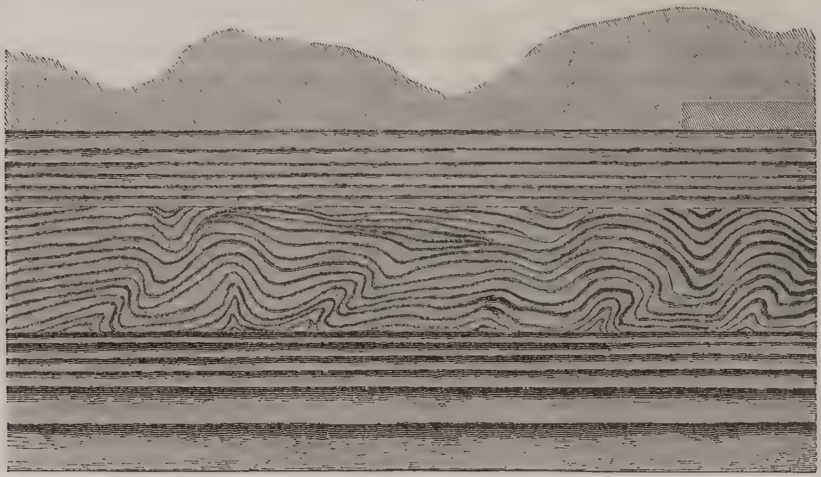
On the north side, and to the west of Little-Falls, the alluvial is of considerable height, the range being but little broken to West-Canada creek. The part next to the village is very different from the usual deposits. Near to the river, it appears to rest upon the primary rock ; the lower part is a mass of black sand, quite coarse, with very small pebbles, the latter showing an arrangement in parallel layers. On the top is a confused mass of stones of all sizes, in which the black limestone of the Utica slate, and fragments of the slate, are in great abundance. To the rear of this deposit, the relative position not observed, is a mass of pure yellow sand. This kind of sand is in greater abundance on the south side of the river, in the angle of the uplift, and at the south and east of the quarry. It has heen heaped up into high hills, rising or appearing to rise from one hundred to two hundred and fifty feet above the river. The ancient river bank is not evident on that side of the Mohawk for about two miles west of the quarry ; it then extends along the river for about five miles, rising about sixty or eighty feet above it ; its surface generally level, and in some places thickly covered with the usual river stones, and showing identity with the bank to the east of the Noses. On both sides of the river the banks are readily traced westward, and gradually appear to sink in the level plain near Rome. Blue clay, which appears to form the base, is seen in many points. A deposit of blue clay was noticed on the west side of Middleville, about sixty or more feet above the creek ; another on the road from Brocket's bridge to Little-Falls, not far from the saw mill.

On Black river, between the High falls and Boonville, there is an immense deposit of brownish clay, which had been partially excavated for the locks of the canal ; it is in layers from two to three feet thick, disposed horizontally, and covered with sand of a yellow color.

At the feeder of the Black river canal, there is an extensive deposit of clay as to length, brownish and yellowish, the greater part in thin layers, perfectly flat or horizontal. The clay is seen from point to point along the feeder, forming its bottom and sides ; no part noticed to rise above the banks of the feeder ; the clay covered in places with yellow sand, the same in kind to the southwest of Little-Falls ; the surface much furrowed, and slightly covered with soil.

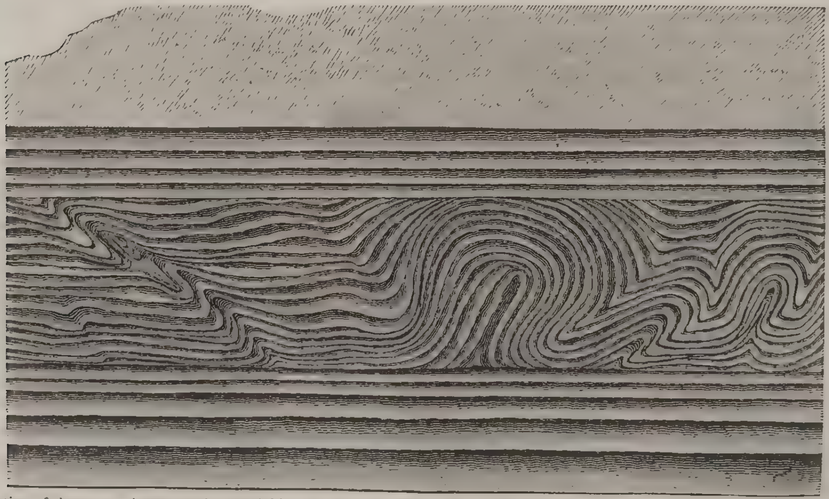
On section eight, about three miles from Boonville, the clay beds are of high interest, showing great local disturbances in parts of their layers, which throw light upon the causes of ancient appearances of the kind. The layers show a series of contortions of different kinds, for which no other cause can reasonably be assigned but different degrees of lateral pressure. These clay beds are exactly represented in the three following wood-cuts. They show different degrees in the amount of disturbance, and most of the different forms which layers assume when disturbed. They are arranged in that order, which commenced with the least degree of disturbance.

72.



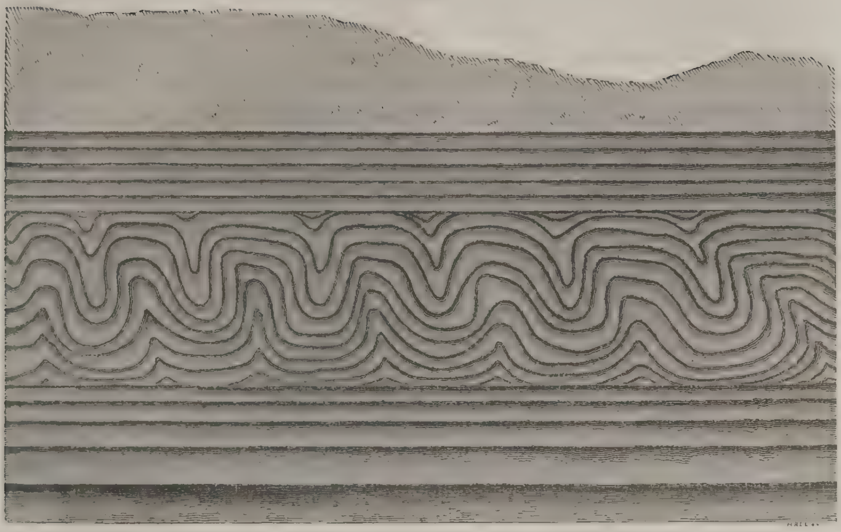
Section on the feeder of Black river, showing local movement in a portion of a series of thin clay beds or layers, those above and below being wholly unaffected by the movement which deranged them. This shows the least amount of disturbance of any of the three sections.

73.



Section of the same, showing a sharp wrinkle or fold, and a high and graceful arching or folded axis thrown beyond the vertical position, exemplifying angular movements.

74.

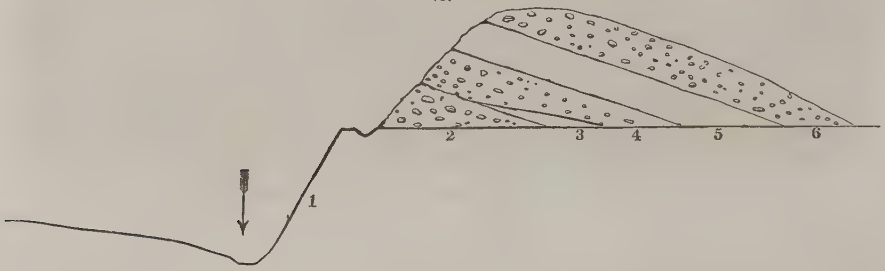


Shows a series of the same large arching and folds, and angular movements.

The above wood-cuts were copied from the drawings of Mr. Amsden, formerly an assistant engineer of the Black River canal, who kindly offered his services to give a transcript in miniature of the forms assumed by those disturbed layers. The engravings show three distinct parts: First, in the descending order, the sand which covers the clay deposit; under which is a range of undisturbed layers or thin beds of clay, resting upon the series of disturbed ones, the object for which the engravings are given; these in their turn, being placed upon a second range of undisturbed beds, which form the bottom of the feeder. The disturbed beds or layers are placed between two perfectly undisturbed ranges; showing the various forms of curvature, contortion, plication, wrinkles or folded axes, by which such appearances have been named. These disturbances extend for a considerable distance along the feeder, though of but little thickness. The beds both below and above the contorted ones, are perfectly undisturbed throughout their whole course, as represented in the engravings; but the disturbed layers do not possess this uniformity, for they exhibit portions that are undisturbed. When the disturbed portions are compared with the undisturbed ones of the same layer, they show that the former were raised, greater space being required by the layer where contorted than where undisturbed. These interesting forms of disturbance were no doubt the result of unequal, local and lateral pressure, which the nature of the country admits; for such forces must have operated when the immense mass of alluvial which once covered all that part of the valley where the Black river now flows, was swept away.

In the instance of contortion given of the Trenton limestone, we had an example where the force was within the mass; here, one of lateral pressure upon very yielding materials, being probably in a softer state than the contiguous undisturbed parts. These instances, so far, afford us the only two known causes of contortion, plication, etc. of rocks; and may explain all the known cases of disturbance of like appearance, without resorting in any wise to forces acting from below. In the rising and falling of great masses — and continents illustrate such movements — a lateral pressure would result, forcing whatever soft or yielding materials were subjected to its power, to act upon themselves; hence plications, contortions and curvatures would be produced, like those of the clay beds of Black river, were the layers thin and yielding to pressure. The same results would ensue, were a part of a mass subjected to crystallization, having insufficient space for expansion, or if unequally resisted by associates.

75.



*Section extending at a right angle from Black river, showing that the materials of which the hill is composed came from the direction of the river.*

No. 1. Apparently a mass of yellow sand, forming the bank of the river.

2. 4. 6. } Rolled stones of primary rock, limestone of Black river, and Trenton rock and sand with loam in No. 6.

3. 5. } Sand same as No. 1.

At the point where the feeder diverges from the river, there are alternations of rolled stones of the largest size, and sand, rising apparently upon a mass of sand, the top of which is about sixty feet above the river. The deposit of rolled stones and sand dip from the river at a considerable angle, showing that the direction whence they came was from the part now occupied by the valley or river depression on that side, the former showing no rise for a long distance from the river. The alluvial hill rises one hundred or more feet in perpendicular height above the river.

The plain of Boonville, south of the village for some miles, and along the whole course of the river to the mouth of the feeder, shows hills of alluvial; rising about the same height as along Black river, but more generally placed upon the Trenton limestone, which forms the surface rock of that part of the country.

On West-Canada creek, above Prospect, the alluvial extends for some distance, showing by the side of the creek a height of bank of sixty or eighty feet. The lower part consists of dark-colored clay, with some rolled stones; above which is a mass of sand; and finally, rolled stones, sand and earth. Towards the mouth of the creek, the banks are equally high; but as the side or face of the deposit was covered by the materials which have fallen from the upper part, no correct opinion could be formed of its nature.

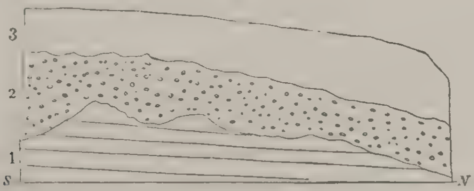
The alluvial which forms the entrance to Steel's creek, in Herkimer county, rises from thirty to forty feet in height, consisting chiefly of clay and sand; the clay is brownish, having lost its coloring matter by exposure. Near the new dam of Mr. Remington's forge, the two materials are much intermixed. Some parts of the sand show accretions, owing to limestone from water, which has cemented the sand, forming a very solid stone.

The clay on the Mohawk and its tributaries often contains some pebbles of limestone, which injures its quality for bricks; the pebbles being converted into lime by burning, slake, and thus mar the quality of the bricks.

Throughout the great level to the west of Oneida county, the blue and brown clays so common to the east section of the district, were not distinctly seen; nor any other than a yellowish or a red-colored clay, in any considerable quantity. The yellowish was common over the counties of Oswego, Madison, Onondaga and Cayuga, north of the Helderberg range, but its position as regards the other deposits of its class was not satisfactorily exhibited in any one place. There are but few points through that section, where any striking superposition of the different deposits was observed, and none in which the whole were exhibited, owing to but few excavations having been made, though hills of alluvion are exceedingly numerous, especially in the counties of Oswego, Onondaga and Cayuga. The best locality noticed is at Chittenango, where three distinct deposits are seen, which separately were observed in many, not to say innumerable places in all those four counties.

The wood-cut No. 76 represents a section of the hill by the side of Judge Warner's house in the village, and in the angle formed by the road which leads to Kirkville, and the street which extends down the creek.

76.



1. The first or lowest mass is a yellow sand in layers, having a slight inclination north, showing that the waters which deposited it had a southerly direction. The top of the sand is deeply water-worn, showing a change of action after deposition.

2. The second deposit consists of rolled stones and blackish sand, arranged in parallels in conformity to the outline of the first deposit. The stones are red and grey sandstone, dark-colored limestone like that of the Lockport group north, and of primary rock; they are all rounded, but not worn flat like those of the shores of the great lakes, being more like those of rivers, round but not discoidal. The surface of this deposit, like the first one, is also uneven, showing disturbance before the upper or third deposit was made.

3. This differs also from the other two, as much as they differ from each other. It consists chiefly of red earth, as if derived from the destruction of the red shale. It contains also some of the stones of the second mass. Whole height of the three deposits about thirty-five feet.

These three deposits are recognized in some of the borings at Syracuse. The upper one, which from its red earth is peculiar and easy to recognize, holds the same position in numerous places. The boring made by Major Byington on the hill at Salina, passed through it. The same red kind occurs in the valley south of Munsville. It is an extensive deposit north of Springport on Cayuga lake, and contains some lenticular crystals of gypsum to be again noticed in the report. It forms the upper deposit also on the west side of the outlet of Owasco lake, resting there upon a yellow sand, under which is a coarse grey sand. These deposits appear also at the village of Auburn, forming a ridge of thirty or forty feet high, which apparently gradually sinks in its progress south.

The same upper alluvial was met with in the hill-side south of South-Onondaga village, and on the road from Marcellus to Clintonville; between Peterboro' and West-Hamilton, and in other places.

The deposition of this mass upon the higher rocks is important; for if not raised from a lower to a higher level, it could only have been carried south at that ancient period when the rocks were greatly extended north, which must be the true explanation of this, as well as of other extensive deposits, which now hold in the third district a higher level than the present outcrop of the rock from whence they originated.

There is another class of deposits, well defined as to position but irregular as to composition, which are worthy of note. They occur in the north and south valleys which are on the south of the Mohawk river and the Great level; or in other words, the Helderberg range forms generally the dividing line between their north and south waters. These waters anciently flowed in one same direction, through valleys still more ancient than themselves; but they now separate, and flow over double inclined planes in opposite directions.

The whole of these deposits have a common character. They are in short hills, quite high for their base, and are usually in considerablo numbers. None were opened, and no opportunity offered to ascertain if any defined arrangement of their materials existed or had been made when deposited. They consist of gravel, of stones also of greater size, sand and earth.

The first deposit is on Sauquoit creek near the furnace, the hills many and high; the next on the Oriskany, between the falls and Waterville; another is in the valley of Oneida creek, south of the point where it turns west, being the depression east of the village of

Pratt's-Hollow. In Onondaga valley there are two deposits, one on the Indian reservation near the mouth of South-Onondaga valley; there the hills are highest, and the accumulation the greatest, some of the hill appearing to be over one hundred feet in height: the other is a lesser deposit, and near the head of the valley. A similar but smaller deposit exists at the head of Otisco valley, near where the road takes a rise into the valley which leads to Homer; also another in the head of the valley which extends south from Skaneateles lake, in the town of Scott. The last great deposit is in Cayuta creek at the head of Cayuga lake, and extends for miles along the creek.

Some of these deposits greatly resemble the hills of loose materials which rise in the valley near Fall and Cascadilla creeks, near Ithaca. The hills appear to have been formed by the waters of the creeks when the lake was at a higher level; for where such substances are deposited in deep and tranquil waters, there is no tendency to diffusion; the head of the lake upon which Ithaca is seated, being a perfect flat.

There are numerous points where the alluvial appears to have been formed over the hill side, besides those near the mouths of the creeks near Ithaca; such is the mass on the west of Onondaga village; the descent into the valley northwest of Waterville; north of the village of Greene in the Chenango valley, etc. etc.

These deposits of alluvion near the line of dividing waters, greatly resemble certain accumulations of similar deposits noticed in the survey of Massachusetts, called *diluvial elevations*.

The whole of the district south of the north line of the Helderberg range, shows an immense accumulation of alluvial deposits, either filling up the valleys and forming level surfaces, or ranging by the sides of the valleys as terraces, or thrown into irregular hills in the valleys, and also occurring on the heights apparently in no regular order. The deposits consist of rolled stones large and small, sand, clay and earth. The rolled stones are in prodigious amount, nearly two-thirds of which are from rocks north of the Helderberg range. They consist chiefly of primary rock, and grey and red sandstone. In some localities, those of limestone are numerous; and where they exist, as their gravel and soil are often present, they give rise to deposits of tufa or lake marl; the former kind if air only be present, the latter if deposited in water.

The excavation of the Chenango canal from Oriskany falls south is entirely in alluvial materials; showing frequently, in the northern part of the town of Madison, a mass of gravel and large rolled stones as an upper deposit. Below the rolled stone, there is often a deposit of blackish or dark-colored sand, fine or coarse, which is the common sand of the whole of the south valleys. The lighter colored sands exist, but are rare comparatively. The lower part of the canal at Chenango forks was in a sand of the kind; above which was a mass of coarse gravel from six to eight feet thick, with rolled stones from one to eight inches in diameter, having on the top finer gravel with thin layers of sand.

The clays in that part of the district are usually of a lighter color than those of the Mohawk: the dark ones exist, but are rare. Small pebbles of limestone appear to exist also in the clay, as at South-Norwich; some of the bricks are apt to burst and crumble after being burnt and exposed to the weather, showing the northern origin of at least a portion of its materials.

In the yellow-colored clay which underlies the swamp back of the village of Woodstock in Madison county, the soil of which is muck or peat, the tooth of an elephant, the Elephas ———, was found in digging a ditch. Attention to this discovery was directed by Mr. Gerrit Smith and the Rev. Mr. Schofield of Peterboro', from whom fragments were received, the tooth having separated into parts by exposure to the air and rough usage. This is the only fossil which was seen, forming a part of the quaternary era, during the survey of the district. A part of the tooth is in the State Collection.

## Sand.

An immense deposit of fine yellow sand skirts the Primary region of the district; commencing at Boonville, and extending along Black river through Herkimer and Montgomery counties into the first district, and appearing to be connected with the mass which overlies the clay deposit between Albany and Schenectady. The localities where it appeared to be in greatest amount, are in the neighborhood of Boonville; in the northern part of the towns of Russia and Norway; from Salisbury corners to Brocket's bridge; west and east of Lasselsville; west of Klip hill; between Kingsborough and Fonda's bush; and near Galway.

The hills southwest of Little-Falls are of the same kind of sand, and have already been adverted to; but no mention was made of finding upon the top of one of the highest near the quarry, large pebbles of primary rock, red and grey sandstone, limestone, etc., and having near its base a boulder of rubblestone, which probably came from its summit. These facts correspond in some measure with observations made by the Geologist of New-Hampshire, page 46, Report of 1841. "The granitic sand is heaped up in hills from Durham to Lee, some of " which are of tolerably regular conical shape, and are elevated from two to three hundred " feet above the general level of the surface. On the summit of one of these elevations, oc" curs a numerous group of erratic boulders of sienitic granite, remarkable for their isolated " situation and great size."

The existence of the boulder of rubblestone at the point noticed, is a fact of some moment in the history of the valley, there being no layer of its thickness west of Montgomery county. The same kind of rock, but in smaller masses, is found in considerable number upon the top of the uplift on the south side of Little-Falls, and have all certainly been carried from east to west, where they are strewed over the surface in great profusion.

## Boulders.

Though the term *boulder* would imply a mass of rock somewhat round, that has been removed from its original position, the word is applied to all masses whether round or angular, the size and the removal to a distance from its native place being the chief characteristics. Two causes are known to produce the rounded appearance which they often present: the first is, friction in the form of rubbing and collision, occasioned by the movement of the boulder itself; and the second, alteration from exposure to the weather, which, commencing with the angles and edges, finally leaves the mass in a globuliform state, should its nature admit of alteration or decomposition. In North and South Carolina, where granite of a readily alterable character exists, rounded masses of the kind are in many parts extremely numerous; they have, however, undergone no change of place, but merely a concentric decomposition in place.

Boulders, with some exceptions, are found over the whole of the district exclusive of its southern border, where they were not noticed, but yet may exist. The whole of them, without an exception south of the Helderberg range, have been transported from north to south, or rather from a northern position. The greater number consist of primary rock, which have been carried a much greater distance than any of the others; and as a general rule, the farther they were seen to the south, the smaller was their size. The distribution of the boulders is very unequal, very numerous in some places, and but few in others. With some exceptions, they are generally found upon the surface, frequently upon the tops of hills or on their sides; appearing in almost all their localities as if but recently dropped, and that no change had taken place subsequent to that transportation which brought them from their original position.

### *Boulders of Primary Rock.*

The most southern part of the district where boulders of primary rock were noticed, was in the valley which leads from Vanettensville to Spencer in Tioga county; they were of the smaller size, and composed of granite. They are not remembered to have been seen south of two miles below the village of Cortland. In Shed's ravine, south of Truxton, there is quite a large one, being from four to five feet in diameter. North of the village, and in the neighborhood, there are a number, but of a smaller size, all likewise of primary rock. They occur also near Preble.

Boulders of the same kind are yet more numerous in the valley at the head of Otisco lake, on the road to Homer. A few appear near Spafford, towards the ridge, between the road and the lake; also on both sides of Skaneateles lake.

Through Madison county, they are seen in numerous places on the hills and hill-sides, extending into Chenango county. One of the largest seen in this county is in the village of Peterboro'; it consists chiefly of white quartz, with a little white feldspar and garnet: it was the largest seen south of the Mohawk.

Boulders are very numerous at the north end of Otsego county, being found on all its hills. They occur in profusion on the limestone terrace to the northeast of Cherry-Valley village, and the enclosures there are principally formed of them. They appear in many of the creeks in the valley, having fallen from a higher level. In the same situation, also, they are seen in many parts of Oneida county south of the Mohawk, as in the ravine back of Dr. Noyes's near Hamilton college; in Bridgewater valley, etc. etc.

Along the Mohawk at Amsterdam village, they are numerous on its east side. In the gap of the Noses they occur, and of large size, appearing as if they had rolled from the cliff.

From Pulaski village over a large section towards Jefferson county, they are in the greatest abundance, and often clustered together; as, for example, at the elevation near the county line, on the Port Ontario road.

Boulders are numerous all over the counties of Montgomery, Herkimer and Oneida north of the Mohawk, and in Lewis county. The greater number and the largest size are found over the alluvial plain near Boonville, which appears to have been a favorable point for accumulation, and a distributing place for Lansing's kill especially. Many of them are beautiful granites, in which red felspar is the chief constituent; in others, coccolite is abundant, and also table spar. Throughout the Primary region, boulders of its rock are of frequent occurrence, particularly in the water courses.

In Lewis county, boulders are found upon all its terraces, and appear to have been carried over on the west side, and distributed thence over the northeast part of Oswego county; so that in the third district, they are found on the south, the west and the northwest of the primary nucleus.

### *Boulders or Blocks of the Transition Class.*

On the limestone range there are boulders from some of the rocks below it, which consequently have been carried south, and raised to a higher elevation when compared with their present outcrop. South of the range, there are numerous blocks which formed a part of its mass, and which have also been carried miles from their original position. The same fact is true also of the Tully limestone, numerous blocks of which exist upon the surface, and partially buried, and for miles south of where it is in place.

The parent rocks of these blocks or boulders, and the distance travelled by the latter from the present outcrop of the former, are well known; and whatever may have been the agency which has brought these boulders to the places they now occupy, the same in all probability effected the transportation of the more numerous and more generally diffused primary boulders found south of the Mohawk valley, all of which had likewise a northern origin.

The terrace of limestone to the northeast of Cherry-Valley shows many large blocks of Oneida conglomerate, which appear amongst the primary ones in the enclosures, etc. They also occur along the same range in Herkimer and Oneida counties.

The Oriskany sandstone first appears out of place, and at a higher level, in Grout's quarry, amongst the drift or alluvion on the top of the Onondaga limestone, the thickness of the Cauda-galli grit and Onondaga limestone being the difference of its original position and the top of the quarry. The sandstone showed characters of a local origin. The same sandstone is found in great abundance, and immense blocks, scattered over the hills in the towns of Madison, Eaton, Hamilton and Lebanon, being more numerous towards the valley of the Chenango canal. They often appear on the side-hills, but few having been noticed towards the middle of the valleys. All the blocks there seen were the counterpart of the mass at

Oriskany falls, being readily recognized from local differences in the rock prevailing at all its points of outcrop. The same rock was also found, but in small blocks, near Skaneateles village, with characters resembling those of its outcrop to the north of that village.

The limestones of the Helderberg division are far more abundantly distributed south, owing to its greater thickness. They may be seen from one end of the district to the other. A few points only will be noticed. In the creek to the east of Cherry-Valley, at a considerable elevation above the valley, and therefore far above the outcrop of their parent's bed, are many large blocks, having fallen from above. They are numerous over the south part of Herkimer and Oneida, but more so in Madison county, in the towns of Eaton and Madison. In the last named town are many lime-kilns, which are supplied by transported blocks. A place was visited, where a large block was buried, except a projecting point, and was supposed to be in place, or in other words, was a limestone ledge. They are also in abundance along the waters of Limestone creek in Onondaga county. Numerous points along the line south of the range of that division show the distribution of the limestone blocks, and the field enclosures are often made of them. Among the kinds the corniferous limestone is very prominent, being easily recognized by its nodules of flint and its fossils.

The Tully limestone, in large angular masses, has been found as far south as about twelve miles from its present outcrop; being about the same distance that the blocks of Oriskany sandstone, at the south of West-Hamilton, are from where the rock exists in place at the falls. The most numerous blocks discovered of the Tully limestone were on the west side of the district, near Cayuga inlet. The largest specimen was found on Six-mile creek, on the farm of Mr. Hollister. It was so large a mass, that, being partially buried, it was considered to be in its original position. At both of these localities, the transported blocks are burnt for lime. The highest point noticed where the same rock appear as a boulder, is near the little mill on the road to Dryden, about two miles from Ithaca.

From the boulders being generally seen resting upon the surface, they have the appearance of having been but recently transported; and thus favor the opinion so strongly advocated, that whilst the portion of the continent of which they form a part was submerged, they were deposited from icebergs. The following facts show that there is fallacy in those appearances; and though ice may have been the instrument of their carriage in the first instance, it probably was of more local origin than marine icebergs. All over the district, boulders are rare in the broad valleys, being always more numerous upon the hills, their sides, and the foot of the hills; appearing to have fallen, or otherwise removed, from the place where they were first let down or deposited. This fact shows that their transportation took place before the valleys obtained their present surface, or their diffusion would be more general; or else those deposited in the valleys have been carried up to a higher level, a fact yet to be ascertained.

One of the causes of the transportation of boulders or blocks of rock, is the sudden breaking of lake barriers, or other large bodies of water; these, in New-Hampshire and in the Alps, have been known to effect the carriage of large rocks for miles of distance. Another, and the more general and tranquil agent, is ice, either in the form of bergs, being parts of glaciers, or of the thinner product of lakes and rivers.

In Russia, according to the recent report of Messrs. Murchison and Verneuil, the operation of raising blocks of rock from a lower to a higher level for example, is well exhibited at about eighty miles above Archangel, where a range of angular blocks of white limestone is piled up about twenty or thirty feet above the river. This has been effected by the freezing of the water around the blocks at the water line, the spring freshet raising and drifting the whole to the new shore; and by thawing, the blocks are deposited at a higher level. The same operation, with the drift from north to south, is more in accordance with the general fact in New-York, than that of marine submergence and icebergs. The absence of all marine productions whatever, excepting those which form a part of the ancient materials of the alluvial, are in opposition to any but a very transient submergence, hardly sufficing to explain the number of boulders which have been let down or cast upon the surface, and leaving wholly unexplained the prodigious amount of northern drift in the form of paving stones, pebbles large and small, sand and earth, which exists all over the counties south of the Mohawk valley or Helderberg range, these drifted materials extending even into Pennsylvania.

An opinion prevails in the United States, that the whole of the boulders have been carried from north to south, and hence a flow or flood of water from the north has been adopted. This is fully negatived by the northern primary nucleus of New-York; and when that of the eastern range in New-Hampshire is examined in all its directions, the facts observed in New-York will be found to be common to both. In the third district the boulders of primary rock are found to the west and the northwest, as well as on the south side of the primary nucleus from whence they originated; and from the observations of Dr. Emmons, they occur also on the north and the east side of the same nucleus; confirming the great fact recorded in Europe, that they are not the result of a flow in one direction, but as it were radiate from a common centre or centres; or in other words, have been distributed on all sides from central upraised or upraising primary masses. This is a necessary conclusion, since the primary masses which give origin to the greater number of the northern boulders now elevated five and six thousand feet above the ocean, were once the lowest as to altitude, and were raised in modern eras; but so long as observations were confined to the south side of these upraised nuclei, as matter of fact no other origin could be given to their boulders, but the one so generally entertained and published.

## Lake Marl.

This substance is a carbonate of lime, which has separated from its solvent, in water; the latter preventing its particles from cohering together, and allowing them to subside in the state of a calcareous mud. It is in many places constantly depositing from waters holding limestone in solution.

In the third district, there are two sources from whence its material was derived: The first and greatest is from the calcareous rocks, and is found in great abundance north of the Helderberg range, and in some of the valleys of the range; the other kind appears to have been derived from calcareous alluvion, and is found chiefly to the south of the range.

In most places marl is a pure carbonate of lime, occasionally discolored by vegetable matter, and containing the common fresh-water shells of the country. But little comparatively is yet used, being made into bricks and burnt for lime, which is remarkably white. In time it will be used for improving the soil, as chalk is in England, and will be manufactured into whiting and paris white.

### *Localities of the first source.*

The first noticed was on West-Canada creek above Newport, in a pond to the right of the road on the east side of the creek.

In Madison county, through the towns of Lenox and Sullivan, it is in immense quantity. A large deposit exists on the south side of Canastota village, between the canal and the hills south. The greatest amount is in Cowasolon swamp, covering several thousand acres. There, as in most of its localities, it is covered with peat or muck. When a part of the water was drawn off from the swamp, by a drain into Oneida lake, a large portion of the muck was carried with it, leaving a snow-white surface of marl of great extent. The marl, it is said, has been sounded with poles, but the bottom not reached.

The same kind of marl shows itself in numerous places in Onondaga county, north of the canal; in the great swamp in the town of Cicero, for example; also near Messina springs. The whole of Onondaga lake is bordered by it, the surface showing accretions of tufa of half an inch or more in diameter; the marl covering the bottom of the lake, and extending north and south of the lake for some distance. It is about six feet thick in all places where bored.

East of the tunnel near Syracuse, there is an interesting section through which the railroad passes, showing in the ditch clay, and two deposits of marl, which separate three deposits of muck with stumps and roots, chiefly of tamarisk or balsam.

Lake Sodom, near the canal in Manlius, is a marl lake; its sides and bottom are covered with this mineral, which its waters continue to deposit; the trees and other objects which have fallen into the lake, being whitened by it. The marl at the bottom of the lake is of a blackish color, owing to vegetable matter; a fact of frequent occurrence in the ponds of the district, and readily explaining the cause of the dark color of many limestone rocks which have had a like origin.

### *Lake Marl from alluvial materials.*

The high ground northwest of Peterboro', on the road to Perryville, shows swampy soil and alluvion with calcareous pebbles, the bottom of the ditches by the roadside exposing marl.

The marl of the lakes or ponds near Cortland are connected with no other materials than those of alluvion. Limestone pebbles are in abundance there, and through the valley north.

The lakes of Tully also are marl lakes, and are similarly situated. So likewise those in Madison county, in the valleys of the towns of Eaton, Madison, Lebanon and Hamilton.

Where deposits of alluvial materials exist which contain limestone pebbles, the water which passes through them will deposit tufa at its egress, unless too rapidly carried off, and united to larger bodies of water from sources of a different kind. Small deposits of tufa from sources of the kind have frequently been found in the southern counties, and used for lime. Numerous other deposits will yet be discovered, when under drainage will generally be practised; for accumulations of the kind must be found in many low and marshy situations in the southern counties, from the great abundance of northern alluvial containing pebbles, etc. of limestone, which there exists.

### Calcareous Tufa.

This product without doubt commenced with the first exudations into the valleys when freed from water, and has continued to form unto this day. It is an exceedingly abundant product, its localities being very numerous, and the quantity prodigiously great at some of them. It differs from marl as before mentioned; the latter having separated from its solvent, in water, by which its parts were kept separate, and finally subsided or precipitated; whilst the tufa, on the contrary, separated where air had access, or its solvent could gradually escape, by which its particles were enabled to cohere and form a solid substance.

One of its most abundant sources has been the calcareous portions of the gypseous deposit; the mass being permeable to water, this fluid deposits the tufa after passing through the mass, and appearing again at the surface of the earth. The deposits generally appear at the sides of the hills or valleys near the point where the calcareous waters issue, and continue down in many instances to a considerable distance, should their course be oblique, or above the drains of the valley, else they are arrested by the waters of the valley. Sometimes where the deposit has been rapid, a mixture of the earth or marl and the tufa takes place; as on Limestone creek, to the south of Delphi; at the hill back of Brothertown in Oriskany valley, etc.

The first deposit of note to the east, is north of Cherry-Valley, on the farm of Mr. Schism, not far below the falls at Judd's mill; large masses appear upon the surface over an acre or more of ground, on the east side of the creek.

A curious deposit, from its cavernous nature, exists in the ravine below the new mill north of Vanhornsville.

A deposit appears on the creek about three miles south of Fort-Plain.

A considerable mass exists on the farm of Judge Loomis, west of Little-Falls, by the roadside. It is a deposit from a copious spring, issuing from the alluvial hill which skirts the north side of the river. The Judge has commenced using it upon his land, and is well satisfied with the result, though but the first year of trial.

Tufa appears in all the creeks along the south of the Mohawk through Herkimer county; the largest deposits noticed were near Fish's distillery, and Myers creek above the furnace, the latter a very solid one, and is used at the furnace, and is burnt into lime.

In Oneida county, it shields large portions of the hill-sides of Oriskany valley, immense deposits existing on both sides, but more exposed on the east side below Ely's sawmill, covering a portion of the side-hill and road. It appears to have commenced in a depression which it filled, and moved from place to place, to avoid the obstructions which it created.

Numerous deposits were also noticed in Skanandea and Oneida creeks, some occupying large areas.

Deposits are numerous in Madison county, near Clockville, Chittenango, &c. They are more abundant in Onondaga county, along the north sides of the gypseous hills through Manlius and De Witt. It is in great quantity towards Split-rock, and especially in Onondaga valley, towards the head of the valley in Tully. Along Nine-mile creek it has the crystalline character of alabaster, showing successive layers also, and in quantity suitable for the smaller purposes for which that beautiful substance is used when polished.

At Alcott's on Limestone creek in the town of Fabius, there is a large deposit, showing the three varieties; the earthy, solid or *horsebone* commonly so called, and the ferruginous. The former kind or variety is made into bricks, and burnt for lime.

There are several places in the district where deposits of tufa have raised mounds, and of some size; such as the one at Richford springs, to the south of Herkimer county.

On the farm of Mr. Grizzle, southwest of Vernon village, near the Indian reservation, the ground around a spring has been observed to rise, and is now about six feet above the general level. The top part is muck, which produces luxuriant grass. From a digging made near the spring, logs of wood encrusted with tufa were discovered: the rise evidently was caused by a deposit of this mineral. At a lower level on the farm of Mr. Adams, there is another elevation, caused by a deposit from the same waters which flow in that direction.

It was to a cause of this kind, the spring being less copious, that the Rock spring at Saratoga owes its stony envelope; the water slowly depositing its carbonate of lime where exposed to the air, and gradually raising the little hollow mound or elevation by which it is so well known.

## Ferruginous Tufa.

In several localities in the district, deposits of tufa and oxide of iron exist, some of which have ceased to increase, whilst others are continuing to form. Of the latter kind, there is a constant deposition going on upon the farm of Robert Riddle, about one mile west of the village of Chittenango. The immediate deposit at the spring shows no iron, but at a little distance it is colored. The ground is low, and favorable for the deposit of bog ore, which no doubt takes place, and thus stains the calcareous deposit. Some of the masses of tufa, when broken, show thin veins of crystallized manganese: the same were noticed in the fourth district, near the Genesee river.

At William Wheeler's, two and a half miles northeast of Salina, tufa is also stained with hydrate of iron. This deposit is quite extensive; it is upon a very gentle sloping side-hill, the surface showing spongy muck, and swampy soil. This locality clearly proves the double source of the two materials; the deposit at the springs being free from iron, and the surface portion only colored by it. These springs, at both localities, appear to derive their material from the gypseous deposit, which rises to the south at both places. The benefit of these calcareous waters are perceived on the farm of Mr. Wheeler, when compared with the adjoining ones; the common sorrel, for instance, does not grow in his fields, whilst it abounds in those of his neighbors.

At Crill's, in the town of Stark, Herkimer county, there is a considerable deposit of the same kind of tufa, covering the hill-side for some distance on both sides of the gypseous adit.

On Nine-mile creek, below the village of Marcellus, a like deposit also exists.

Near Saltspringville, north of Cherry-Valley, a spring issues from the hill-side, which also deposits iron and tufa. The spring was not visited by the reporter. It was said to have been used as a paint.

A similar deposit occurs in the valley just below the village of Genoa, in Cayuga county. There it is equally obvious that the iron is a deposit from a mucky soil, the waters which yield the calcareous deposit coming from a lower level.

From the connection of specular iron ore with limestone upon the northern slope of the primary, which is evidently a water-worn surface, its first great deposit subsequent to the ore having been a mass of sand, these ferruginous tufas are of interest, pointing to a like origin for those products; both having been subjected to crystallization, the particles of iron were brought together to form the specular masses; whilst the carbonate of lime, as the greater product, served as a matrix or envelope.

## Bog Ore, Limonite, &c.

This very common, though not an abundant product in the third district, is caused chiefly by the decomposition of iron pyrites; by the decomposition of rocks, or their minerals, containing iron as a constituent; and from the soil by decomposing vegetable matter, as explained in the first report of the fourth district. This kind of ore usually lies in low places; and where so few excavations exist in such situations, but few deposits could be met with. As the country increases in population, and the swampy soils are drained, the ditches made for that purpose will afford information, which could not be obtained during this survey without resorting to manual labor which formed no part of its plan. Less attention also was given to it, as being more properly a mineral than a geological product, in a survey where the subjects are divided as in this.

In the course of the survey, numerous places were visited where ore was said to exist; but not one offered much evidence of profitable quantity, nor can any be mentioned which promised abundance. The localities are numerous where it exists in comparatively small quantities, and some of these may not be far removed from large bodies which the future will make known.

Near Constantia furnace in Oswego, it was said to be in abundance, but was not examined. Among the localities visited were the following: Below the outlet of Oneida lake, above the rift; near Colliersville, in the low grounds of the valley, in Otsego county; on the farm of

Mr. Hug, near Adams' saw-mill, in Spencer, Tioga county; on Tipple's farm, three miles southwest of Verona; and on the farm of Mr. Shed, to the south of Truxton. At this latter place it is in pebble-like particles, distributed through the soil over an area of several acres.

At all the uplifts, by the side of the calciferous rock, and where fractures existed in the limestone rocks along the Mohawk, this kind of ore was common, appearing as an exudation from the rock.

## Peat or Muck.

This is an exceedingly common, and in many parts of the district a very abundant product, constantly forming in certain low situations. The condition for its production appears to be permanent moisture, or rather water; and where this is made to flow off by drainage, it ceases to accumulate. Where peat exists, the soil or subsoil upon which it rests is either clay or marl, impermeable to water, this being an essential condition for its existence. It is formed of successive growths of the same or of different kinds of vegetation, which have lost life, and have changed to a brown of different shades, sometimes almost black. Usually the kind of plants which form it can be distinguished, and again the vegetable structure only is apparent. In Maine, Dr. Jackson, its geologist, found peat exhibiting the compact nature and color of coal.

Though the production of peat in the first instance requires the lowest level, it is so spongy and retentive of water, that by successive growths it raises its bed and appears in mounds and hillocks. This result is aided greatly by deposits of tufa, which, in several localities in the third district, constantly form beneath it. Usually the surface is more or less soft, yielding to pressure, often shaking or trembling when walked upon.

Throughout the district, no use has yet been made of it. Its two great uses are for fuel and manure. From its immense abundance through the low grounds of Oneida, Madison, Onondaga and Cayuga counties, so soon as the forests are all levelled, and a higher grade of fertility of the land required, it will be in demand, the purer kinds for fuel, the others for manure.

Some of the larger deposits, and a few of the others only from their interest will be mentioned. The canal to the west of Rome shows that a large body of peat, and of good quality, exists there. The same is seen at Cowasolon swamp, appearing to be much the largest body in the district. By the road from Chittenango village, it shows in a ditch that at least two successive growths of tamarisk existed on its border, the lower one underlaid with lake marl.

The digging of the enlarged canal between Canton and Bellisle, shows a considerable deposit of peat, of six or more feet in thickness. It shows also, in some parts, alternations of marl, the latter in very thin layers.

The alluvial flat below Little-Falls shows, by the ditches which have been cut through it, that it is underlaid in part with peat.

It was noticed also in the valley of Cherry-Valley, on the land of Dr. Campbell; thickness supposed to be twenty feet, but the extent not over two acres: Again on the land of Mr. Clark, near Cooperstown, covering an area of five or six acres. All through the southern valleys, it exists in the swampy grounds, but they are but small patches when compared with the deposits along the great level.

The most interesting deposit of peat noticed, is to the east of the tunnel near Syracuse, in the deep grading of the railroad. The ditch by the roadside shows a deposit of clay of a dark dove-color; upon which is muck or peat, showing a range of stumps and roots, chiefly of tamarisk or balsam; some of the stumps are eighteen inches in diameter, and the whole is covered with lake marl. On the top of the marl, there is another deposit of muck, and tamarisk stumps, etc.; and then a second deposit of marl, the top of which forms the present swampy surface; making three successive growths of vegetation above the clay, separated by two beds of calcareous marl.

There is a strong odor of sulphuretted hydrogen along that section, which is very offensive at times, and is unusual for such deposits, and merits investigation; showing clearly that sulphuric acid has been decomposed, and also water: the former was probably derived from the gypseous waters of the region. This fact throws light upon the origin of sulphuret of iron, so universally associated with coal; and of carbonate of iron also, which too is an associate, but not so uniform a one: they may thus be explained.

When soil, vegetable matter and water exist together, and air is excluded, it is evident from the deposits of iron ore which take place in low grounds, that this mineral is rendered soluble in water, and becomes insoluble by the action of the air, and precipitates. Now if gypseous water be present, or any sulphate, its acid will be decomposed, and its sulphur will unite with the iron and form pyrites. Where iron is in excess, the carbonate of iron will be formed by the union of the oxygen of the acid and the carbon of the vegetable matter. The latter may also be, and no doubt is formed, by the mixture of vegetable matter, water, and oxide of iron of such deposits; air being excluded, and the vegetable matter being in decomposition.

These deposits of muck or peat show clearly how the vegetable matter which forms coal beds was accumulated; and when coal beds alternate with limestone, as they do in some countries, how such alternations may have been produced. Were such deposits suddenly depressed and subjected to great pressure, the heat which would result, and which could not escape but slowly, would give a homogeneous character to the vegetable matter; and were the marl sufficiently moist, it would, without igneous action, finally exhibit a crystalline character.

The constant association in all coal formations of beds of shale, which were but deposits of mud, and what is termed *fire clay*, both of which are common associates of all coal beds, is precisely in accordance with the common fact with regard to peat: both having an impermeable floor, and water being required for a continuous vegetation, making perfect the analogy between the two deposits as to origin.

Connected with peat, is the production of acid, probably sulphuric, which is found to the north of Cherry-Valley at Mr. Schism's. Below his sulphur spring, are two small mounds from three to four feet high; the surface composed of black muck-like earth, which has a sharp sour taste. The mass is so soft that a stick may be thrust into it for several feet. The part below the surface yields sulphuretted hydrogen. In the hot seasons, the whole mass, it is said, presents a foaming appearance, and is very soft. The effects observed are doubtless due to the sulphur of the water, vegetable matter, and air.

## Soil.

In this part of the survey, if any thing was expected beyond the collecting of soils for analysis, there must be disappointment. A survey, to be productive of benefit as regards agriculture, must be something like the plan pursued at this time in Massachusetts, but combining a knowledge of the geology of the subsoil as to local or distant origin, and the kind as to rock. Divided as this subject was between the chemist and the geologists, as the former could make the selection for analysis with much more efficiency in all respects, it was considered better to leave it with him altogether, though with no decided understanding upon the subject. In good faith, the subject was attempted in the beginning of the survey; but when the number of rocks was found to be so great, and the alluvial or transported materials so abundant and so generally diffused, it did not appear possible to attain to any useful results, even the most general, until the survey was completed. The letter of the survey could readily have been complied with, and the soils collected and analysed; but judging from the attempts elsewhere made, it is not very probable that any very satisfactory results would have been obtained. What cannot be done to advantage under the circumstances in which we are placed, had better remain unattempted until there is a prospect that it may be successfully accomplished. The preliminary knowledge to a useful and therefore a creditable collection of soils, is a geological survey, which shall make us acquainted with the materials from whence soils were derived; that is, with the different rocks and their distribution, for from these sources all soils proceed; and which shall at the same time put the collector on his guard as to the two general kinds of soil, those of the decomposition of the rock in place, and those of transported materials. The next step is a knowledge of the nature and growth of the various objects of man's culture.

Where a State like New-York possesses an agricultural association coëxtensive with its territory, each member possessing a full knowledge of the soil or soils of his section, with the aid of a geological map, and a comparison of facts with each other, analysis would not fail to furnish useful results. But greater no doubt would be the gain, were the geological and local agricultural knowledge embodied in one individual, possessed of the other necessary requisites; for in this case, there would be greater unity of action, and of course a corresponding harmony in the results.

As a chemist and a farmer, the reporter has not attached sufficient value to the analysis of soil, to have one made of the land he cultivates, though admitting that benefit to agriculture would follow if rightly conducted. Analysis should have a comparative definite object: For example, to determine the nature of the soil of the large divisions of the State, where but one rock exists, and the soil is its product: Why different native growths, not far distant from each other, differ where no cause is apparent, unless from difference in the soil, and this not apparent to the senses? Why land which formerly yielded wheat abundantly, ceases to produce healthy wheat, and that but in small quantity? A question which could be answered by the analysis of such soil, and the same in a hedge row or elsewhere near by, where the wheat could not be sown. Were the subject pursued in some such manner, the utility of the analysis of soils would doubtless soon be apparent; but continued in the old or present mode, the good received would be of little moment.

The greatest benefit, I should suppose, which is to await the agriculturist, is from rotation; all other methods being secondary to it. It is the great law which geology makes known, and thereby confirms the first chapter of Genesis, which asserts a succession. One thing prepares the way for another, and an order of succession has been established from the beginning. The kind of plants which the farmer ought to grow, and their order of precedence, should be one of his first lessons. Next to rotation would be mixtures of different earthy materials, especially those of opposite quality from the soil to be improved, which probably may be one of the causes why change becomes necessary; and hence a shorter rotation might advantageously be pursued, for the great benefit of this operation may arise from the change which plants produce in soil by excretion, decay of materials, and mechanical action.

From the great body of well informed practical agriculturists now engaged in improving their soil by earthy mixtures of various kinds, manures, saline materials, and rotation, it is hoped that agriculture, a subject so obscure and yet of such vital importance, will, by the conjoined aid of theorists versed in its practice, take its rank among the exact sciences; and as it is the basis of civilization, it will in practice be considered among the most ennobling of human pursuits, and become consequently the prime element of education.

Certain earthy mixtures which contain no nutriment, such as the marl of New-Jersey, possess a highly fertilizing quality, the efficient cause of which is as yet unknown; for it can not be the potash contained therein, as was formerly supposed, since in that case micaceous or primary soils would be more productive than they are. Too little attention it seems to me, has hitherto been given to the effects developed by the action of the sun's rays on different colored particles in the soil: the whiter particles producing reflection in excess, may give rise to a repellent force; while the darker colored ones, being less reflective, receive the full influence of the calorific rays, and thereby evolve the elective affinity, or force of combination. By the assiduous study of the laws of these two forces, which have a close analogy with the powers of life, we would probably do more to remove the difficulty in question, than by following any course which has been hitherto pursued.

No fact is more obvious than the connection generally between rock and soil, and soil and population. Where all things else are the same, the number of inhabitants in all countries where man cultivates the earth, and is unfettered, are in direct proportion to the goodness of the soil. This is exemplified in every part of the district. The best soils are those of the dark limestone rocks, and limestone slate and shale; the next, the argillaceous slates and shales; the inferior ones being of primary rock, and the light colored coarse sandstone; of the truth of which facts, there are few farmers in the State who have not knowledge.

### Mineral Springs.

These are numerous in the district, and of considerable variety. They are of importance in many respects, besides the purposes to which many of them are applied by man: they show the soluble substances of the rock from which they issue; and they furnish materials for filling the joints and other fissures and cavities of rocks, to which all veins both of metallic and of stony minerals owe their origin. Many obtain their mineral contents by simple solution, such as the brine springs, the proof of the existence of common salt being shown by the hopper cavities associated with the gypseous masses. Others, such as the sulphur springs, are not so readily explained; for though the essential element exists in pyrites combined with iron, and few rocks are without this mineral, yet I am not aware that any satisfactory explanation has been given of the mode by which the sulphur is separated. That a separation is effected by natural processes other than by heat, is certain from its being found as a crust lining cavities where pyrites existed. Besides the source of sulphur in pyrites, it exists also in small particles in the group of rocks wherever springs of that kind are most numerous and copious, being found in the plaster quarries on Cayuga lake near Springport, and near Camillus in Onondaga county. Since the sulphur is combined with hydrogen at all the different mineral springs in the district, it is certain that water is decomposed, the hydrogen being the immediate solvent of the sulphur.

The subject of mineral springs properly belongs to the mineralogical department of the survey; and Dr. Beck, in his usual way, will give ample information of them. In some points of view, such as the rocks from whence they issue, and their origin, they are more properly the subjects of this report, and to such it will be confined, giving what is to be said in a very brief manner.

The connection between certain kinds of rocks and mineral springs, is far more intimate than would appear to the casual observer. Thus, for example, where primary rock alone exists, be the country where it may, we have no brine springs; and those of other kinds of salts, and the sulphur and acidulous springs, are so rare, and their waters so small in quantity, as to be almost unworthy of note; neither do they give origin to thermal waters, though the lowest in the whole series which form a part of the visible surface. They give rise to some chalybeates, but proverbially the waters which issue from primary rocks are the purest. The class of the carbonated saline springs in New-York is confined wholly to the Hudson river group, and includes the Saratoga and Ballston springs, and the waters obtained by boring at Albany and near Hampton in Oneida county, and are found in this State in no other rock or group.

The brine springs, or those of common salt, have a higher range. They appear first in the same group at Saltspringville, near the line of Otsego and Fulton counties, but this is the only locality where the brine was sufficiently pure to be made into salt.

The next rock as to age, of these springs, is the Medina sandstone, in which brine, by boring and by springs, is known to exist, from the middle part of Oswego county to the Genesee river.

The third being the great source of these all-important fountains in the State, are those of the Onondaga salt group, separated from the sandstone below by the Oneida conglomerate, the Clinton and the Niagara groups ; the whole of the brine having been furnished by the rock, and relatively to the rock are of local origin.

The fourth source in the district, of springs of common salt or brine, are those of Triangle in Broome county, which will be noticed under the head of that county ; they appear to be near to where the Ithaca and Chemung groups unite.

The sulphur springs have a more extended geological range, being found in many more different rocks, and in numerous localities. They exist in the Utica slate, as in the creek near Utica ; and near the junction of the Oneida conglomerate and Hudson river group, as in Steele's creek, Herkimer county. They are numerous and most copious in the Onondaga salt group, this being the maximum rock for numbers and quantity of water. The springs commence with those at Sharon in the first district, and end to the west of Auburn. A sulphur spring issues from the slate of the Hamilton group, at the foot of the falls on Handsome brook near Sherburne ; another from the Genesee slate, on Cayuga lake ; and the springs at Dryden are connected either with the Ithaca or the Chemung groups. In all these different rocks, with the exception of those of the Onondaga salt group and the springs at Dryden, they probably owe their origin to pyrites, the quantity of water discharged being also small.

Two opinions exist with respect to the origin of mineral springs : in the one, they are considered to be deeply seated, and to have a common source ; the other, and the only one which is in accordance with facts, regards them as surface waters, percolating different masses, giving rise to chemical action in some, and in others to a mere solution, dissolving the saline or other materials which they meet in their progress, and reäppearing again at a lower level with new properties collected during their passage.

# CHAPTER IX.

*Embracing excavations or denudations, valleys; lakes; scratches upon rocks which have been smoothed; and mounds.*

### EXCAVATIONS, VALLEYS.

No part of the Union presents such obvious and extensive excavations as New-York, and it is owing to this circumstance that such facilities are offered for the study of its rock masses. Reversing the order in which the excavations or denudations have been made as to time, the first, being the lowest depression of the district, is Lake Ontario. The accordance of the rocks on both its sides, and the dip of the rocks, are altogether favorable to its being a lake of excavation. No other cause could have given rise to it, but the sinking of the mass which forms its area; a supposition which is not in harmony with the nature of its outlet, and dip of its rocks on all its sides; the parts of the whole being in perfect conformity to each other, and in accordance with a lake of excavation.

The next and more extensive excavation or denudation, is the Mohawk valley and the Great level; these comprehend all that part which extends north from the Helderberg range, to where it thinned out, or originally terminated, and which is as yet wholly unknown. As the Marcellus shales and the Hamilton group rise in hills, and in some points quite near the edge where the range commences, it is certain that from the top of the range to the bottom of the valley of the Mohawk river, including the Great level, was not the whole height from where the excavation commenced, but that it ascended yet higher.

The third and last series of excavations, and the highest and first that were made, are the north and south parallel valleys and their lakes to the south of the Helderberg range; they are coëxtensive with the district, and disposed over its surface at intervals of a few miles.

The assertion that these valleys were first excavated, is founded upon the fact, that in every one of them, and over their hills, the larger portion of their rolled stones are of northern origin, consisting of primary rock, grey and red sandstone; the latter sometimes showing its Fucoides harlani, and amongst them occasionally some of the harder varieties of Pulaski sandstone with its peculiar fossils. These stones are in such prodigious number, that their existence where seen can only satisfactorily be accounted for by the extension of the rocks north, which, by the dip of the rocks, would gradually bring them upon the same plane; just as we now find in the valley of Cherry-Valley, for example, going south by the valley of the Susquehannah, a regular declining plane from the Onondaga limestone to the Catskill group, though constantly ascending in geological height.

It might be conceded that icebergs had been the agents for the transport of the boulders of Primary rock so profusely scattered over the same surface; but when the amount of rolled stones, and even earth which has been carried south, and the extent of surface over which the boulders are distributed, are well considered, their origin from that cause is not more admissible than for the rolled stones, especially since innumerable facts exist in the district, of boulders of a local origin having been transported from every lesser distance to that of twelve miles, and from north to south invariably; making it certain, that whatever cause effected their removal, could, by an increase of degree, remove those of a more distant region and of different origin, such as those of primary rock. Nothing is more certain than that a cliff composed of rocks like those of the Helderberg range could not have existence, unless the result of a fault, of which there is not the slightest evidence, but must have been produced by the erosive action of water. From the nature of its mass, it evidently must gradually have thinned out north, unless high rocks there existed, of which there is no evidence; and as all its products, with the exception of the Oriskany sandstone, have been of the nature of mud, they must originally have been level.

In order satisfactorily to account for all the loose materials which are scattered over the surface to the south of the Helderberg range, the great mass of those materials having been collected in the valleys, nothing more is required than an extension north of its rocks, which must have existed, so as to bring those of a lower level, by the dip or inclination which the rocks have, upon the geographical level which contains their products; and to bear in mind, that the Primary nucleus between the three first districts to the northeast rises to three times the height, at its highest point, of any of the boulders of its mass in the third district; and moreover, that the whole of the rocks upon which the boulders and other products rest, incline in a mantle-form manner from the Primary nucleus.

The first of the valleys of the Helderberg range to the east, is Cherry valley. It is of great interest, rising twelve hundred feet above the Mohawk river, and showing at the village of Cherry-Valley a sojourn of water upon the Corniferous limestone, and again upon the Onondaga limestone, the latter now forming the bottom of the valley; also an intermediate one, upon which the principal north and south street of the village is placed. The Onondaga limestone extends to the edge of the great east and west range, showing there a solution of the rock at its vertical joints, which cannot be explained without a movement of the water from a south to a north direction, thus reversing the great ancient flow through the valley; unless by an inadmissible supposition, that the north end of the range was at that time excavated below the limestone, and admitted the water by its vertical joints. The Marcellus shales and the Hamilton group extend north on both sides of the valley, and appear near the edge of the range, circumscribing the mouth of the valley.

The next valley which rises upon the range is Bridgewater flats, the northern termination, or rather commencement of Unadilla valley. It shows a handsome broad level flat, made up in part of northern rolled stone, as is evident from some portions of the flat, and from excavating below its surface. Its eastern side, towards the north, shows the Onondaga and Corniferous limestone, the erosion of the range having extended to a lower level than at any point farther east.

These valleys, and these only are here noticed, because they are the only ones which show, from the edge of the Helderberg range, the original bottom of the valley, with their northern products ; no water having flowed over their northern part, since the change in the relative heights of the north or original Mohawk and the south waters. The whole of the valleys to the west of Bridgewater flats show the double inclined plane ; the present waters dividing to the south of the Helderberg range, and flowing north and south in opposite directions.

## LAKES.

The lakes to the south of the Helderberg range, are an important and interesting feature of the district, furnishing facts to show that the excavation of those at the west end of the district was anterior to the dip of the rocks, in all that part of the district which lies to the southwest of the primary nucleus. Exclusive of Cayuga lake, there are six of note : Otsego, Schuyler, Cazenovia, Otisco, Skaneateles, and Owasco ; the two first at the east end of the district, slightly inclining in direction to the west of south ; the three latter at the west end, inclining to the east of south. These six lakes are entirely to the south of the limestone range, being seated wholly in the lower part of the Erie division. Cayuga lake has the same range with the three to the west, but extends about seven miles north of where the limestone range is found on its border ; but it is no farther north than Skaneateles lake, owing to the destruction of the range near Cayuga lake. The lakes to the east have their outlets to the south ; those of the west, to the north. The whole of these lakes differ in no respect from the long parallel north and south valleys of the same section, but in depth of water and apparently greater depth of excavation.

The great depth of several of the lakes, Skaneateles being 320 feet, Cayuga 396 feet; their outlets being shallow ; the exact accordance of their sides not admitting of faults ; the nature of the mass in which they are seated, not permitting of subsidence without too extravagant a supposition ; the south ends of the lakes to the west terminating in the higher rocks, the elevation increasing south, render it impossible for the waters which excavated their basins to have passed in that direction.

There yet remains one supposition, which is, that of their excavation before the present dip was given to their rocks ; the difference between the original horizontal and present position of their rocks fully accounting for the greatest depth observed in the lakes.

Should the excavation of the lakes have been made by a flow from the south to the north, it complicates the history of the surface of that part of the district, the rolled stones of northern origin showing a flow in the opposite direction. Whatever be the real facts as to the flow of waters in opposite directions, patient investigation in time, if true, will harmonize their results; for truths only apparently conflict with each other, the real conflict being solely in the minds of those cccupied with them.

### *Otsego Lake.*

This is a handsome sheet of water, and is elevated 1193 feet above the ocean. It has a high ridge of the Hamilton group on the east side, a low and an interrupted range of the same on the west side, and an elevated projection at the northeast end, the lake extending further north on its west side, with an inlet on its east side. At the south end there is a dyke of alluvial, upon which Cooperstown is seated. The valley of which the lake forms the head, spreads out to the southwest, the lake being one of the head waters of the Susquehannah. Length of the lake about seven and a half miles; average width, one mile and a half.

### *Schuyler's Lake.*

This is also one of the head waters of the same river, and is surrounded by the same group of rocks; the country less hilly. The lake in great part appears to have been formed by a dam or dyke of alluvial, the materials having been carried into its depression from its sides. Another dam occurs lower down at Oakville; and a third one, yet lower, at the factory. Length of the lake nearly four miles.

### *Cazenovia Lake.*

This is a beautiful lake of its size, the high points around it consisting of the Hamilton group, and the lake extending into the Marcellus shales at its north end. It divides north into two branches, one heading towards the valley of Limestone creek. It discharges its waters at the south end, which flow into Chittenango creek.

### *Otisco Lake.*

This is a small lake, deeply seated in the Hamilton group, its waters flowing north. The hills rise south; its inlet narrow; forming a valley whose hill-sides rise three hundred feet above its surface. The bottom of the valley forms an inclined plane, ascending to the broad valley of Preble and Homer. Its bottom shows rolled stones of the usual kind, which are thrown into hills near the large valley. Length about three miles; average breadth about half a mile.

### *Skaneateles Lake.*

The sides of the northern end of this lake gradually slope to the water, corresponding in inclination to each other, and adding greatly to the beauty of the lake. The south end is more narrow, and the banks rise to a considerable height, and abruptly from the lake. The water line of the lake, with the exception of the south part, is excavated in the Hamilton group; the Tully limestone and the Genesee slate appearing to the south of Borodino, rising when first seen about one hundred and fifty feet above the lake; and the Ithaca group, commencing still further south, surrounds the head of the lake. The greatest depth appears to be south of Borodino, the deepest sounding being 320 feet. This lake is about eighty feet higher than Owasco lake. It is about fourteen miles long, and varying from about a half to a mile and a quarter in breadth.

### *Owasco Lake.*

With the exception of the foot of the lake where the Marcellus shales must appear, the outlet near the village of Auburn being in the lower part of the mass, the whole of the lake is in the Hamilton group. Its length is over ten miles; its width at the south end about a half a mile, increasing to a mile and a half at the north. The foot of the lake is flat and covered with alluvial; rolled stone is abundant on the east side of the foot, and sand-hills on the west side, covered in parts with the upper deposit of Chittenango. Along the outlet the water has uncovered numerous boulders of primary rock, and blocks of limestone, which show the composition of the flat which forms the foot of the lake. At the head of the lake is the fine broad deep valley in which Moravia and Milan are seated, the bottom of the valley constantly rising going south for about fifteen miles.

### *Cayuga Lake.*

This lake forms a part of the west boundary of the district. The northern part, to near Springport, shows the Onondaga salt group, or the gypseous deposit. The range of the Helderberg terminates a short distance below the same village. The Marcellus shales and the Hamilton group range near the water line as far south as Bell's ferry and Goodwin's point, where the lower edge of the Tully limestone comes within a foot of the lake, concealing all but that part of the group. As the limestone rises by the bending of the lake to the east, the Hamilton group reäppears, showing about sixty feet of height at Ludlowville; from whence it diminishes in height, and disappears to the north of Bloom's lime-kiln. The Tully limestone first appears on the lake near the north line of the town of Genoa, curves apparently with the group upon which it rests, and ends its course at the kiln. The two remaining masses of the east side of the lake are the Genesee slate, and the Portage and Ithaca groups; they are first seen to the south of Salmon creek, and the slate disappears about half way between the lime-kiln and the head of the lake.

This lake is nearly forty miles in length, and averages about two miles in breadth, being wider towards the middle than towards the extremities. The greatest depth is 396 feet.

### *Lake Ontario.*

(Signifying, according to Father Hennepin, "as much as to say, the pretty lake.")

This lake forms a part of the north boundary of the third district. Its origin is of some importance as to the original state of the Great level, and the origin of the lakes to the south of the level.

The opinion that Lake Ontario is a lake of excavation, is rendered highly probable from the circumstance that its northeastern end on the New-York side towards the outlet is composed of rocks, none of which are higher in the series than the Trenton limestone, whilst the rocks which border it on the west are the red sandstone of Oswego and its overlying ones. Between these two points, allowing but fifty feet to be excavated in the red sandstone, one hundred feet in the grey sandstone under it, thirty for the sandstone shale of Pulaski, two hundred for the Frankfort slate, and one hundred and twenty feet for the Utica slate, the whole making a thickness of five hundred feet, is about equal to the real depth of the lake, the surface of the Trenton limestone being its bottom. That this is but an obvious inference from well ascertained facts, admits of no doubt, the aggregate thickness of the different masses being undeniable; and moreover a guide or rule by which to calculate the level of the Trenton limestone, is equally well established; a position, however, which may not be so evident, and therefore a knowledge of the following facts is necessary to make it so.

In order to ascertain what was the nature of any given surface as to level, it is but necessary to attend to the materials of which it is composed. Thus, mud, for example, tends to spread itself uniformly over any surface upon which it may fall, provided that it be deposited in water; in which case, its particles being kept separate, the mass continues to flow, spreading itself uniformly over the surface until it finds its level. Such also must be the case with carbonate of lime, when it separates from its solvent, as is verified in every deposit of marl in the State; the hollows gradually filling up, and the surface becoming horizontal. The Trenton limestone shows a twofold origin: that of marl or carbonate of lime; and that of mud, from whence the shale which causes its divisions, and with which it is often intermixed, was derived. The fact moreover is universal, that all rocks of sediment, when undisturbed, are horizontal; and therefore were the Trenton limestone and its overlying rocks to be returned to their original position at any level that was above the ocean, the basin of Lake Ontario would appear to be a basin of excavation; the rocks which rise upon the Trenton limestone forming its sides, and this latter rock its lowest surface, covered with the sediment of the tributaries of the lake.

The excavation of the lake presents no greater difficulty than the removal of all the overlying masses of the Great level, and those of the Mohawk valley, which must have taken place; for the Helderberg range has extended north over a considerable surface, as well as its overlying rocks, the whole having thinned out originally, there being no higher elevation by the side of which they could have been deposited.

Should this lake be, as believed, a lake of excavation, this effect was anterior to its present dip, and the period which preceded the change of inclination of its rocks was the one in which the basins of the southern lakes were also formed or excavated.

### *Oneida Lake.*

It forms a part of the long and broad level which commences near Utica, and extends through the third district, dividing the counties of Madison and Oswego. Its length is about nineteen miles, and its greatest breadth six miles; its greatest depth is said not to be over sixty feet. In general it is shoal, and the lake grass or weed may be seen in many parts to a considerable distance from the shore. It has two small islands, which appear to be of alluvial origin. It is excavated in the Clinton group, the rocks of which appear on the south shore, and at the west end. Its north shore is entirely covered with alluvion, which is low at the west end, but rises to a hundred feet towards the east end. The banks of the outlet are low, as well as all that part where it unites with Seneca river.

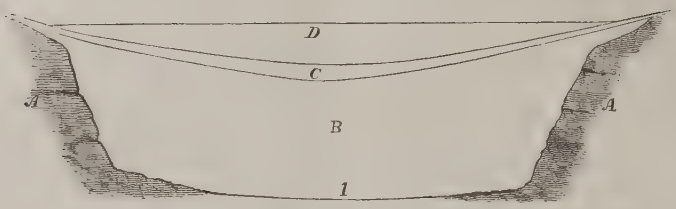
This lake is beautifully seated, when viewed from the north side. The gypseous hills rise with rounded outline from the low green border of the lake; back of which is the more elevated range of the Helderberg, upon which the more distant ends of the north and south ranges of the higher rocks appear.

### *Onondaga Lake.*

This small but interesting lake is about five miles in length, and about a mile in breadth; its greatest depth sixty-five feet. It is the remains of an ancient and deep excavation in the Onondaga salt group, of which Onondaga valley forms the southern part; all which has been filled up with sand, gravel, etc., except the part occupied by the lake. The last boring which was made in the ancient excavation at the head of the lake, extended 265 feet below the surface, without reaching the bottom. The bottom of Onondaga lake and its sides are covered with lake marl, showing a thickness where bored of six and more feet.

One of the advantages of the survey, has been to throw light upon the salines of Onondaga, showing their true nature, which is now well understood. The ancient excavation of which the lake forms a part, has been filled up with alluvion, forming a reservoir, into which the waters are received which have percolated through the gypseous range, at some distance to the south of their outcrop, and dissolved a portion of the saline materials of that range. The various borings and wells at the salines are connected with the reservoir; the deeper they have been sunk in the alluvial, the stronger is the water, the marl of the lake insulating the salt water of the reservoir from the fresh water of the lake.

77



*Showing a transverse section of the ancient valley and the present lake.*

A transverse or east and west section of the reservoir, as in the wood-cut above, would show the red shale AA, forming the sides and bottom of the ancient valley; the valley B, filled up with alluvial; C, the line of lake marl; D, Onondaga lake, being a part of the valley not filled with stony or earthy materials.

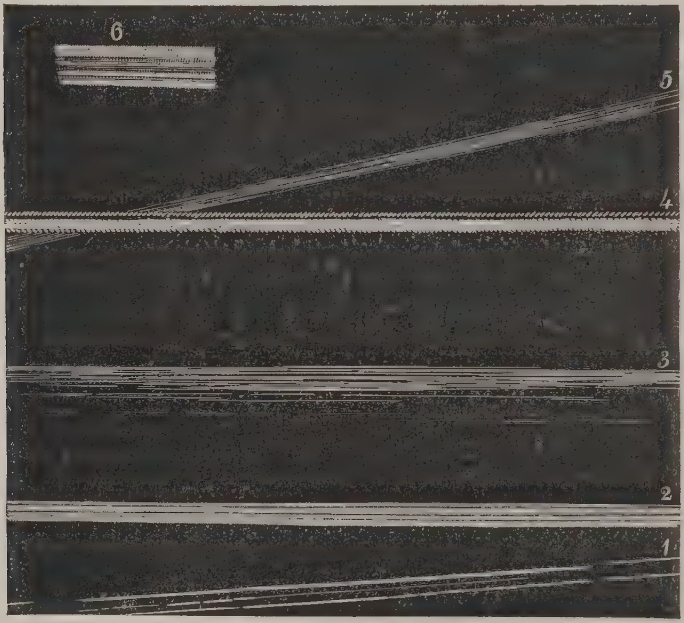
### *Lake Sodom.*

This lake is small, but of peculiar interest from its great depth, circular form, depositing marl, and from its waters near the bottom being highly charged with sulphuretted hydrogen. Its greatest depth is 168 feet. It is excavated in the lower part of the second deposit of the Onondaga salt group, and the red shale below that deposit. For further particulars, the reader is referred to the Report of 1839. This lake is of importance in showing that deep excavations exist along the range of the gypseous deposit, and that the deep excavation of Onondaga valley is not an anomalous one.

### Scratches and Furrows upon Water-worn Rocks.

The worn surfaces of rocks, and the scratches in determinate directions which they often present, are now an interesting subject of geological inquiry, in the greater part of all Northern Europe and in this country. One of the best localities in the third district for observing these phenomena, is at the limestone quarry of Mr. Marcellus, commonly called Schelpintown, situated about two and a half miles to the northeast of Amsterdam. The surface of the rock is covered with soil and earth, which, when removed, show a water-worn surface with two or three sets of scratches, exhibiting great regularity, and having a common direction towards the east, one set of which is about eight degrees south. The scratches, including furrows, were generally from a mere line to one-fourth of an inch wide, and from one to two-tenths of an inch and more in depth.

78.



*Specimen from Marcellus' quarry.*

No. 1, has no parallel on the specimen: It is evidently of an older date than some of the others.
2. This, with 3 and 4, belong to the same set. It shows the effect, when examined, of a tremulous movement.
3. Lines which are slight, and some of them not continuous through the specimen.
4. This exhibits finely the effect of the vibratory movement, and resembles lace.
5, is a scratch of an older date: It passes under, or is crossed by No. 4.
6. Part of No. 2, magnified to show the tremulous motion which produced a succession of fine nicks.

The preceding wood-cut represents a specimen in the State Collection, from this quarry, of more than ordinary interest. It shows three different sets of scratches as to parallelism. The last that were made are remarkably well defined; two of them show that the moving power which produced them, passed over the surface with a vibratory or tremulous motion. It is finely exhibited in No. 4, which presents, on both sides of the scratch, a series of continuous nicks, which could only have been produced by a like movement. The parallel scratch No. 2 shows the same operation, but imperfectly without the aid of a glass; and being more deeply marked, it would appear that the greater pressure was upon that part. What adds greatly to their interest is this fact, that the last made scratches are delicate in their delineation, and as fresh as if the work of yesterday; making it necessary that a sudden movement should take place so soon as finished, by which the shallow waters ceased, and a covering of earth was deposited upon the surface of the rock, under which, like the works of art in Pompeii, the scratches have been preserved to our day.

The surface of the same mass of limestone, at Stanton's quarry to the east of Port Jackson, opposite Amsterdam, has likewise been worn smooth and scratched, and in an east and west direction. These quarries are at very different elevations; one rising about fifty feet above the Mohawk, the other at least two to three hundred.

The same water-worn or smooth surface also appears at Sage and Reed's quarry, about four miles west on the same side of the river, with also narrow scratches having the same direction.

The conglomerate at the point of the hill at Mason's quarry, between New-Hartford centre and Utica, faces the Sauquoit on one side and the Mohawk on the other. It shows, in several places where the soil which covers it has been removed, a water-worn surface, the pebbles of the rock reduced by grinding to all imaginable dimensions. The scratches upon that which was exposed were but faint, and in the direction of the lesser or Sauquoit valley.

The same rock, on a similar point near the Oriskany to the north of Stebbins' creek, and not far from the Chenango canal, shows a like water-worn surface, and with faint scratches in the same north and south direction.

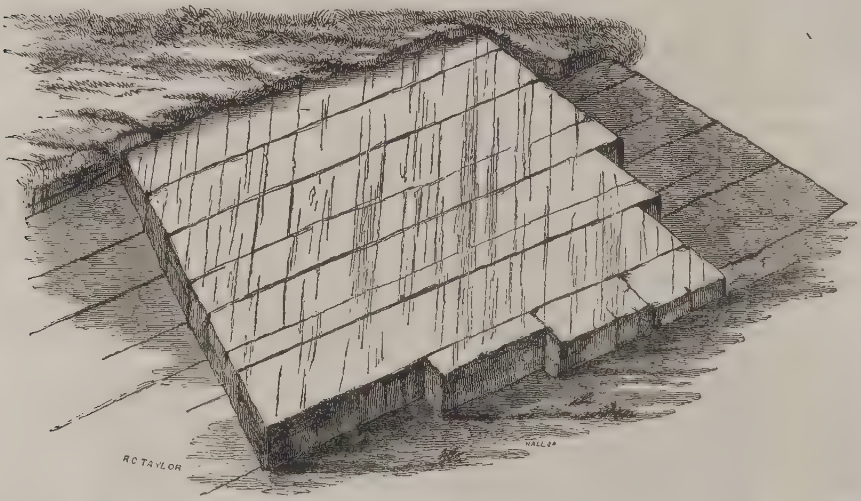
The hard encrinal mass, which corresponds with the position of the upper ore bed of the Clinton group, forms a point or projection on the west side of the Oriskany, to the north of Hamilton college. This point has been water-worn, and covered with alluvial. In removing a portion of the latter at one of the quarries, subsequent to my examination, Dr. Penny saw scratches upon the rock, in a north and south direction, and corresponding therefore with the Oriskany valley.

The calciferous sandrock on the north side of the Nose, for several feet above the road, to the east of Spraker's house, shows a water-worn appearance, with scratches, though not deep; they were also parallel to the course of the river, or its valley.

These doubtless are but a few of many points, where a water-worn surface with scratches may be seen in the third district; not having made them an object of search, but merely noted them when they came under observation. The facts in the third district in respect to them, are these, that they belong to no particular rock, to no particular elevation; and that their direction corresponds with the direction of the valley, or of the valleys by which they are placed. The same observations were made conjointly with Mr. Mather in the first district; there, some scratches appear which are of great interest from their elevation. Two sets were noticed on a terrace not far below the Catskill mountain house; one set ranging with the Hudson, the other the range of the group of mountains. Another set, remarkably well defined and of considerable length, is at some distance from the foot of the mountain, towards the river, and ranges with the river.

The next wood-cut, representing the well defined layers and joints of the Onondaga limestone at Split-rock quarry, presents also a scratched surface, indicated by the oblique lines which traverse it with some interruptions. The lines are in a north and south direction, and in accordance with Onondaga valley. The drawing was made with a threefold object: to show the well defined layers, the joints, and the scratches

79.



These water-worn surfaces of rocks, and their scratches more particularly, are among the many interesting phenomena of geology: The first record the flow of water where none now exists, and to which the smoothness of the surface in great part is owing; and the second, the sliding movement of a hard and heavy body propelled across the smoothened surface of the rock. In these latter times, the scratches have attracted great attention, and two ways of accounting for them are proposed. The first is that of icebergs, which have grounded and moved over the points where the scratches appear, at the time when the continent was supposed to have been submerged; the bottom of the iceberg containing fragments of hard rock, as doubtless many of them must, having all been formed upon the land; and such have actually been seen on the ocean, the fragments encased in the ice, in fashion like the diamond of the glazier.

The second mode, the more recent explanation, and now the more generally received, being the result of actual observation, and the more probable one of the two, is that which attributes their origin to glaciers. These bodies have the weight required; they are well known to have stones of all sizes affixed to their lower surface; water flows beneath them, and their movement commences near the line where perpetual snow ceases, and continues to the bottom of their valleys. The glacier origin harmonizes with the fact that the scratched surfaces are found at no regular or defined elevations; that the surfaces are too much worn, and extend over too great an extent of the same rock, to have been caused by icebergs, especially as the lines are always straight ones, and the motion of icebergs oscillatory and rotatory. The direction also of the scratches is in accordance with existing valleys, and hence local, agreeing with glaciers in both respects. And besides we have no actual knowledge that icebergs produce such results, though there exists not the least difficulty in conceiving that like results may have been produced by them. As matter of fact from actual observation, the glacier theory will have preference of the two, especially should the term *local ice* be substituted, being a more general expression, glaciers having their origin near the line where perpetual snow ceases; whereas local ice embraces the same, as well as all bodies of solidified water, be the cause of the reduction of temperature what it may, whether permanent or transient, that has given rise to it. In another point of view, the local system is to be preferred to that of icebergs; for should the very varied forms of organic remains, which date from the end of the Chalk deposit, be due to greater changes of temperature; also should the destruction of the mammoth, and numerous animals of warmer regions forming a part of the alluvials in Europe, etc., correspond with the era of the scratches, no better cause could be imagined than a fall of temperature destroying life; the glaciers forming barriers of a perishable nature, from whence floods would result, as known to do in the Alps, the effects of which would cover up in part the remains of animals destroyed.

## Mounds, &c.

From the facts collected to this time, mounds appear to be of twofold origin, natural and artificial. Those which have come under my notice, are referable to the former and not the latter origin.

The depression in which the quarry at Marcellus village is seated, widens east, and gradually opens into a flat towards Onondaga valley. On Mr. Cox's farm, about three and a half miles from the quarry, a high well-sloped mound appears in the middle of the flat, perfectly insulated on all its sides. It is made up of sand, earth, and rolled stones such as red and grey sandstone, limestone and primary rock. In the upper part, the sand and gravel in part are cemented by tufa, showing that a connection had existed with calcareous waters of a higher level. The sides of the flat show a similar alluvial mass, from which a portion projects like a mound, requiring only to be insulated and rounded at the part now attached, to be like the one in the midst of the flat. It would appear that the whole of the flat was once filled with the same material of which the mound is composed, the removal of which left the mound, it having held a neutral position.

There is another elevation, which would pass for a mound, were it seated in a plain or flat; it is in Fulmer valley, Herkimer county, to the right of the road going up the valley.

The mounds which I have seen, descending a part of the Ohio river, were at the junction of a tributary with that river; appearing to have been caused by the removal of alluvial banks, the mounds holding the position of an eddy, with the two opposing currents which swept away those parts within their vortex. In the same manner it is easy to conceive, that when two bodies of water meet at right angles, carrying loose materials, the greatest deposit would take place where their forces neutralize each other; and from the circular movement which results, a mound in form would be produced. Those seen, however, appeared to have been caused by the removal of contiguous parts, and not by accumulation.

That mounds are also of artificial origin, and the work of the aboriginal inhabitants, is also unquestionable, from the observations of Dr. Locke of Ohio, and other western observers. In New-York, earth-works of art have been met with, showing that the same labor could also have thrown up the earth in the form of a mound. These earth-works were seen, one near Elmira, the first year of the survey; and a second to the south of Fort-Plain, near the mouth of Oxtungo creek. The points chosen were just where two water-courses meet, the sides of the bank being steep. These works are placed at a few hundred yards from the point of junction, and consist of a bank of earth extending from creek to creek, gently sloping on the outside of the triangle, the ditch from which the earth was taken to form the bank being within the triangle. These works appear to have been made for the purpose of entrapping deer; it being easy to pass over into the area, but not so easy to return if pursued. They are here noticed, to show that works of earth were formed by the original people of the country, and that mounds may have been formed by them also; and that undeniably, as in the flat to the southeast of Marcellus village in Onondaga county, they are the result of what are termed natural causes, and belong to the quaternary period.

# CHAPTER X.

*Brief account of the Rocks, &c. in the order of their superposition, beginning with the lowest, of each of the thirteen counties, and the half of Tompkins county, which compose the Third District; the order of the counties being as stated in the Letter to Gov.* SEWARD, *and in the Table of Contents.*

## 1. MONTGOMERY COUNTY.

Under this head the county of Fulton is included, for no other reason than to avoid the repetition which the division would create, and as being generally better understood. The whole area of the county lies to the north of the great elevation or Helderberg range, and contains a less number of rocks than the counties to the west through which the great elevation extends. The rocks are, 1, Gneiss of several varieties, granite, etc., being the Primary rocks; 2, Potsdam sandstone; 3, The Calciferous group; 4, The Black river limestone; 5, Trenton limestone; 6, Utica slate; 7, Frankfort slate and its sandstone. Of these, four only, to wit, Nos. 1, 3, 6 and 7, form important masses as to the surface which they cover.

The Primary rocks cover the northern part of the county, their greatest breadth being to the northwest. They bound the Sacandaga valley at the northeast; turning to the southwest a few miles below the line of Hamilton county; forming the high ridges known by the name of Mayfield and Kingsborough mountains; turning west to the north of Kingsborough village, and joining Klip hill, the north prolongation of the Noses. They form Royal hill, and pass into Herkimer by an irregular line inclining to the northwest. The primary forms a part of the great central mass, being one of the portions of its border. Beyond these limits, it appears but in two places: On Zimmerman's creek, below Lasselsville; and on both sides of the Mohawk, forming the base of the uplift of the Noses at the east end.

The Calciferous group forms three areas to the north of the river, nowhere extending more than a mile to the south of its border. It forms the whole surface of the east end of the county, excepting some partial overlying masses. It forms the great south portion of the Noses, and the greater part of the space between the ridge to the east of Mother creek, Little Sprite, and East-Canada creeks.

The Utica slate separates the three areas of the calciferous; the eastern edges ranging conformably with the lower rocks, and the western unconformably, being the edges upturned by the uplifted rocks. The first of these masses forms that fine section of country, in which Johnstown is placed near the centre; the other, is the one through which Garoga creek flows from Ephratah to Palatine church. There are, besides these two large areas, on the north side of the Mohawk, a few insulated patches: One on Frenchman's creek, in the town of Broadalbin; a second, back of St. Johnsville; a third, on East-Canada creek, extending by Manheim bridge to the falls at the uplift; and a fourth, on Little Sprite creek.

South of the Mohawk, the whole of that portion of the country, excepting a few strips by its border, is covered by the Utica slate and the Frankfort rocks; the latter occupying the whole southern half, and the former the space between those rocks and the river.

These are the four important masses in the county as to the extent of surface covered, the others occupying very small areas. The Potsdam sandstone appears upon the primary at Klip hill, between the two roads which lead to Johnstown; it is in small patches, of one or two layers, being all that remains of a once continuous mass. The same rock no doubt forms a part of the base of the calciferous, for the present united with it.

The Birdseye limestone is quarried in the town of Mayfield, at Peter Fonda's in Claus patent. It appears in two insulated hills to the west of Eva's kill; in the small quarry on the west side of the dam; back of Amsterdam village; and at the quarries of Tripes hill: the rock at these latter places is thin, and not suitable for heavy work. On the south side of the Mohawk, it first appears at Fort-Plain; it is there in thick layers, and quarried for the canal; also on the opposite side of the river, between the turnpike and the railroad, forming the surface rock for many acres of area. A small quarry exists back of Palatine church, and the enclosures to the west of the village along the road are made of that rock. The two last places where it appears near the river, and is quarried, is at Smith's on the south side of the river, and further west opposite to Lower St. Johnsville. North of the river, the Birdseye limestone is quarried near Crumb creek, on the farms of Helmick, Canada, and Klock. The last place where the rock was noticed, was in Garoga creek, near the village of Ephratah.

The upper mass of the Black-river limestone, of which the birdseye forms the lower part, embraces the greater part of the grey limestone at Amsterdam village, the quarry at Schelpintown, Stanton's quarry at the east end of Port Jackson, Putnam's quarry to the east of the village of Tripes hill, the west quarry near the river at the railroad depot, Sage & Reed's on the opposite side of the river, and Humphrey's quarry between Fultonville and the Noses.

The Trenton limestone is but little quarried in any part of the county, its layers being generally too thin for building stone, and the birdseye and the intermediate mass being preferred for making lime. Those layers which contain numerous shells, such as Orthis testudinaria, are often used for fire-stone in asheries, the edge of the rock being exposed to the heat. The rock was seen in the town of Mayfield; in two places in Broadalbin, to the east of the great Vlie; at Amsterdam; Tripes hill; Sage & Reed's; on the turnpike to the east of Caughnawaga; along the south side of the uplift of the Nose, in the road to Root post-office, and in the creek to the south of Spraker's basin; at the dam in Canajoharie creek; at Fort-Plain; to the northeast of the quarry on the opposite side of the river, and to the west of the quarry;

at Palatine church, in the creek; in the creek to the east of the uplift opposite St. Johnsville; upon the birdseye of the quarry of that uplift; near Crumb creek; below Ephratah; and on the east branch of the creek above that village.

It is very obvious from an inspection of the map of the county to the north of the river, that other localities of the rocks which are placed between the Utica slate and the Calciferous sandrock will be discovered; for as the rocks have been raised from east to west, those intermediate to these two will be seen on the east side of the slate, that being their line of outcrop, whilst the west end of the slate will show those only which have been protruded through its surface; all which, near the line of junction, have been removed, excepting the calciferous and the primary. One of the obstacles which prevents the intermediate rocks from being seen along the line of their outcrop below the slate, is the abundance of alluvion upon the surface of the Calciferous group, offering a strong contrast in this respect with the Utica slate, whose soil is generally the result of the alteration of its own materials, showing but little transported materials.

The land slopes to the Mohawk on both sides of the river throughout its course in the county, with the exception of the northeastern and northwestern portions; the former inclining to the Sacandaga river, and the latter to East-Canada creek. The whole of the county which is occupied with the Primary rocks is yet a wilderness, excepting some portions along its outside border, and others again where facilities for sawing and getting out lumber exist; and it must remain uninhabited, until roads and other conveniences for transportation are made. It is thickly covered with forest, and contains numerous lakes, which are disposed upon its southern and western border, showing the height of the level land, from which the more elevated hills and ridges of the Primary region usually rise. In several attempts made to examine the rocks of the interior of the region, but little could be observed in comparison with its margin; commencing on the east side of Sacandaga river; following its range on the northwest side of Northampton, and the continuation of the same in Mayfield, Kingsborough, Klip hill, Royal hill, and thence on through Stratford and Jerseyfield. Very little variation of rock was noticed along East-Canada and its branches, being generally the rock of Little-Falls. The country on that side is much more level than on the east side.

One of the first prominent points going east along the Primary range, is Royal hill. It is one of those high, long, narrow, north and south ranges which rise abruptly, like Klip hill and others quite numerous in Saratoga county. It is composed of gneiss, similar to that of Little-Falls, and in many parts divided by numerous joints into angular blocks. It is inclined to the east, such being the direction of its lamellar minerals. There was nothing extraneous discovered in this hill, but a little plumbago and small garnets. This hill forms the west side of Pleasant valley, and extends up to near Garoga lake. The valley is covered with alluvion, but it is probable was once underlaid by the Utica slate, which may yet there exist, as waterworn fragments of it are numerous at the foot of the high bank below Pleasant-Valley village, which could not have come from any point south, no fact of the kind having been observed in the Primary region. The valley of Garoga creek separates Royal hill from Klip hill, the prolongation of the Noses. From thence the Primary mass rises to the east, and near Kingsbury village attains considerable elevation. For about six or seven miles, the course of the range of primary is to the north and east, and its height uniform, appearing as a ridge. Beyond, it is broken into rounded or curved masses of different elevations, etc. There is a much greater variety of gneiss at the east than at the west end, in that section of country. On Mr. Clark's farm, about two and a half miles from Kingsborough, the rock is quarried for the village. It has a striped or ribbony appearance, being a well-characterized gneiss, and contains numerous small red garnets, which give a brownish color to the rock, the mica being black. Green feldspar is very common in the rock. Further north there is an abundance of beautiful porphyritic gneiss, suitable for all purposes to which granite is applied; its structure being but slightly schistose, and which would favor its extraction. The hills, or mountains as they are here termed, rise about five to six hundred feet above their base, the latter being elevated about eleven hundred feet above the Mohawk, as was ascertained for the purpose of connecting the waters of the Sacandaga with the Mohawk.

The junction of the Primary and the Calciferous sandstone, from Royal hill to East-Canada creek, is concealed by alluvion. The country from the creek to Lasselsville consists of rounded elevations, sandy, loamy and clayey, between which the small water courses of that section pass on their way to the Mohawk. East of the village there are sand-hills, and the remains of a gravel bank; and from thence to Royal hill, gravel hills, composed of stones from the size of paving stones to small gravel. The country is much broken by rounded and irregular elevations and depressions; showing, from Royal hill to East-Canada creek, a line of agitated waters, resembling the one which extends along Black river to Boonville.

At Pleasant-Valley, the alluvion is of great thickness, its hills rising to about one hundred feet of elevation. It continues up to Garoga lake, the banks of which are now a swamp, owing to a dam of but a few feet, which caused their overflow. The hills extend below the mill near Garoga village, and pass east towards Kingsbury; and from thence by the line of dividing waters south of Fonda's-Bush, into Saratoga county. The great mass of the chain of hills east of Garoga creek is of yellow sand, the same kind with that of the Primary region. The whole chain is like a line of dividing waters, especially that part which is between Kingsbury and Saratoga county; the wind and the waves having united their forces to heap up the sand of the beach.

The Vlie, or natural meadow and swamp which extends along the creek of that name to near the Fish-house, are the remains of a lake, and show the preëxistent state of that country; the drainage of which happened at successive periods, as is beautifully shown, and the extent of alluvial action also, near where the upper and lower roads unite, which lead from Cranberry post-office to the river, near the hill or mountain side. There four well defined alluvial banks exist, resembling great steps or benches, ranging by the mountain side, which forms a semi-amphitheatre, changing by a curve from a northeast to a south-southeast direction. The upper bank of alluvion rises about a hundred feet above the river; the next below, about eighty feet; the third, from thirty to forty feet; and the lowest, from ten to twelve feet. The upper one is of sand, the second of bluish clay covered with sand, and two lower ones of sand and gravel.

The Vlie, or natural meadows, are numerous in many parts of the district: they are the prairies of the west upon a small scale. Their soil, being composed of minutely divided parts or fine earth, is favorable for grass, the rapid growth of which smothers the germinating tree. This is the primary cause why trees do not exist where grass is rank; the others are but subordinate ones. One and all in the district show the same origin, having been ponds or lakes receiving the wash of the country which they drained, the finer particles of which being diffused through their waters, have, by subsidence, formed their level bottom, and their highly productive soil for grass.

## 2. Otsego County.

The surface of the whole of Otsego county consists of high broad ridges, having generally a common south and west direction, their sides rounded, and separated by long, deep and usually broad valleys. The northeast corner of the county terminates abruptly towards the Mohawk river, presenting a succession of cliffs, being the continuation of the Helderberg mountain of Albany county.

The northeastern part of the county presents the series of limestone, etc. which forms the Helderberg division. This division passes through the upper parts of the towns of Cherry-Valley and Springfield, resting upon the Frankfort slate and its sandstone, these latter constituting the larger part of the upper member of the Champlain division. No part whatever of the Ontario division exists at the extreme east end of the county. It commences not far west of the road which leads from Cherry-Valley to Fort-Plain, showing the Oneida conglomerate and the Clinton group, and these two masses are continuous from thence to the west of Rochester.

From the southwest dip of all the rocks of the county, their highest point is towards where the Helderberg range or cliff joins Schoharie county; and from that point, they all decline to the southwest, rising one above the other.

The whole of the limestone of the county is confined to the Helderberg division, and therefore is found only in the range of the northern ends of the towns of Cherry-Valley and Springfield, and the extreme northwest corner of Richfield. It is the most valuable part of the county for its mineral products; lime being an essential element in all buildings for the use of man, all important for the improvement of soil, and requisite for a whitewash where cleanliness and sweetness are required.

The Helderberg division exhibits two portions of the Onondaga salt group: The first or lowest is the calcareous shaly part, from whence the sulphur springs to the north of Cherry-Valley issue; and the second, the harder and more calcareous part, in thin regular layers, which overlie the first part. On the top of the latter mass is the Water-lime group; above it is the Pentamerus limestone, showing three divisions; then the Catskill shaly limestone; next above, the Cauda-galli grit; the Onondaga limestone, or the marble rock of the valley, then follows; and finally the Corniferous limestone, the latter rock showing that its surface was an ancient river or valley bottom, being the upper mass of the division. Neither the Oriskany sandstone nor the Schoharie grit were seen in place, though doubtless both exist in the county.

Quarries are opened in the range of the division, for burning its stone to lime ; for building ; for flagging, and for marble ; all which were noted under the different rocks of the division.

The *Marcellus shales* rest and rise on the limestone range, and appear on both sides of the valley at Cherry-Valley, showing the interrupted layers of impure limestone at the lower part, being well exposed at the ashery to the south of the village, and in the creek on the opposite side of the valley. The shales also appear at the head of Otsego lake, where several excavations for coal were made ; and extend also by the head of Schuyler's lake, along the northern part of Richfield into the next county. The shales and the Hamilton group, at the northeast of the village, are but little remote from the verge of the limestone terrace.

The *Hamilton group* is the next in succession, covering nearly one half of the county; crossing it from east to west in a broad but not very regular belt, owing to the south dip of the rocks and depth of the valleys, and appearing below North New-Berlin on the Unadilla ; below Garratsville, on Butternut creek ; at the north line of Laurens, on Otsego creek ; below Portland, on the Susquehannah ; and near the line of Maryland, on Elk creek, passing thence about east into Schoharie county. Whilst this group appears south in the valleys, the higher and overlying groups cover the hills extending themselves in a measure proportionally north. The great body of the Hamilton group in the county, consists of the harder kind of shale ; the two other kinds, though they exist in the county, form but a small part comparatively of the whole group.

*Upper part of the Erie division*, consists of the Portage, Ithaca and Chemung groups. From the want of accurate knowledge of these fossils and their range as to superposition, which were formed during the period which elapsed between the deposit of the Hamilton and Catskill groups, being the position of the above groups, but little can be said of a precise nature ; for in all deposits of mixtures of sand and mud, forming sandstone, shale and slate, such as compose these groups, the fossil contents furnish the only character which can be relied upon. Happily the unsettled state of this subject involves no consequence whatever of a practical nature, being but a matter of science, where the sequence of the order of creation, and for every part of the globe, is the object ; the instinct of science within us being to reveal the creator or creative power as matter of positive knowledge, by means of the visible works, as contradistinguished from the revelatory or poetic principle. Whatever of these intermediate products exist in the county, will be found in the towns of Worcester, Maryland, the lower part of Milford, the upper part of Oneonta, and in Laurens and Butternuts. The whole of that part which one or more of these groups may occupy, is colored of a light umber upon the map.

*Catskill group.* This is more readily recognized by the predominance of sandstone, red sandstone and red shales ; from the peculiar oblique structure of its upper masses, and from the existence of thin beds of cornstone. It enters from the first district, where it covers a considerable surface and is of great thickness, appearing to thin out in its southwest course, which no doubt was the direction of the northern line of its deposit. It caps the hills to the southwest of the village of Oneonta, and continues thence along the river into Chenango county. It covers the whole of the surface of the town of Unadilla, the southwest part of

Onconta, considerable portion of the higher parts of Butternuts, and the south part of Laurens.

## 3. Herkimer County.

This county has great length, but not much breadth comparatively. Extending farther to the south than Montgomery, it contains more rocks.

The line which separates the Primary rocks from those of the Transition class, commences a short distance above Brocket's bridge on East-Canada creek, pursues a west course for about two miles, and then strikes Spruce creek near Salisbury centre, and continues up the creek; and by a curve, passes to the north of Black creek, not far from Ives' tavern; and continues on the north side of the creek, about a mile or two from it, into Oneida county. The whole of the Primary rock, with the exception of a small portion at Little-Falls, and at Middleville, lies to the north of this line, extending through the wild and unsettled parts of the county.

Very little of that region is settled; the parts inhabited being in the town of Salisbury, and along East-Canada creek to Noblesborough, and a portion of the border of Black river. In general, it is thickly covered with forests, concealing the surface and its rocks. Through Salisbury it is hilly, but no determinate direction noticed for its hills. In Jerseyfield, and further north, the surface is more level, appearing to be divided by very low ridges, their direction somewhat east and west. North of Brown's tract, from the lakes, it is hilly and mountainous, and the country very rugged. On the south side it appears to be less so, the highest point of the line of dividing waters being north of the lakes. The soil, in all the parts in Salisbury that were visited, appeared to be comparatively fair, but rough; sandy and loamy in the middle or Ohio section, and rather stony in the direction of John Brown's tract, on the side which faces Lewis county. Along the route to the tract, in numerous places, rough rounded stones of primary rock were abundant, covered more by moss than soil; they had none of the smoothness of river stones, but had evidently been rounded by the action of water. Similar stones were observed upon the top of one of the highest ridges which bound the lakes on the north side, but in a depression of the ridge, where a tree had been blown over.

There were no rocks seen in any part of the region, but those of gneiss and granite, a little hornblende rock, an aggregate of granular carbonate of lime and coccolite noticed in the report of 1838, and some singular aggregates of a similar kind with feldspar, having the appearance of a breccia, but evidently the result of accretion. These were seen at the east end of the fourth lake, within the borders of Hamilton county.

Where a country is thickly covered with forest, the surface is almost universally concealed by rubbish, moss, etc., so as to admit of but little examination beyond what is required to ascertain its predominant rock or rocks. Although many hunters and others have traversed the region, with a view to the discovery of ores, etc., yet but one locality of ore is known, the magnetic iron ore of Gifford and Congdon in the town of Salisbury, noticed in the report of 1840, and by Dr. Beck. There is another which Mr. Johnson, long a resident at Brown's tract, said he had discovered, but the locality kept to himself: all the information given, was that it was about twelve miles north of the fourth lake; that the vein was two feet wide, and shows itself for thirty rods.

The most interesting feature of the wilderness region is its chain of lakes, placed so nearly upon a level that but little labor from man is required to connect those of three counties together. The lakes of Herkimer and Hamilton are arranged upon a line which is parallel with the St. Lawrence river and Ontario lake, and with the Ohio, &c.; appearing not to be a coincident merely, but the result of a law whose operations were in their direction, and on several parallels. These lakes, were a communication opened from east to west, would be much resorted to. The beauty of their waters, their elevation, and the wild scenery which surrounds them, would not fail to attract visitors. The country will remain for some time unsettled, in consequence of the rich lands which encircle the whole of the Primary region not being fully occupied, and of the facilities given to westward travelling, where land is as cheap and far more productive. A great and good result will take place, when the forests of all that region are removed, and the soil opened to the sun. The mean temperature will then be increased, and frost will be less common in the season of vegetation.

Throughout the whole of the Primary region, there was little to interest in the geology of its rocks, they being chiefly aggregates of quartz, feldspar and a little mica, and sometimes hornblende. Its surface features were of far more interest, but of little bearing upon the object of this report.

Between the Mohawk river and the Primary region, the surface of that part of the county is covered mainly by the Utica slate, the Trenton limestone and the Frankfort slate; the second rock covering the greatest extent of surface, and the last named one the least; the calciferous and the birdseye are but in small amount.

The *Trenton limestone* is the first surface mass which extends from the Primary region south, covering the town of Russia and northern part of Norway, showing the birdseye below it, not far from Ives' tavern near Black creek. The surface of the Trenton limestone is, in many parts, thickly covered with alluvion. At Ives' the limestone rises and forms a hill which appears to extend towards the head waters of Spruce creek, but the connection was not followed up. On Spruce creek, not far below the parallel of the village of Norway, the calciferous appears near the creek, upon which is the birdseye; the Trenton limestone forming a part of the valley, rising into the side-hill, and covered by the Utica slate, the latter extending thence continuously over a large area.

The Trenton limestone continues south along West-Canada creek, from Russia; rising into the side-hill, where the lower rocks appear from under it and cover the valley; being readily traced where not covered by soil or alluvion, until finally lost towards the mouth of the creek, where the waters and Utica slate come together. The rock is exposed in Multona creek, on the road to Fairfield from Middleville; a quarry of the birdseye having been opened at the mouth of the creek, under the Trenton limestone. On Stony creek below Middleville, and in other points of that section, the limestone also appears.

Where a black marble is wanted, the Trenton limestone can readily furnish all that may be needed : It takes a good polish ; some of it is very fine grained, of colors varying from grey to black, the latter often relieved by the white or light-colored fossils which are so profusely buried in this rock. Trials of this limestone from Rathbone's, opposite to Newport, have been made, which showed a fine polish, and handsome surface.

The limestone also appears on East-Canada creek, at the uplift below Brocket's bridge, and at the uplift of Little-Falls on both sides of the river ; the south end showing the limestone upon the top of the uplift, from whence it may be traced continuously to the west of Parmlee's quarry near the canal, where it disappears under the Utica slate.

The *Utica slate* forms in general the higher elevations of the county south of the Trenton limestone, and those north of the river ; the exceptions being caused by uplifts, and the appearance of the Frankfort slate which covers Hasenclever hill : the lower part of the mass contains, in this county, the thin flag-like layers. The slate lines the south border of the river at the east end, extending about two to three miles from the river, and diminishing in width at the west end. Along the north side of the river it is concealed by alluvion, which extends along the river from Little-Falls to Oneida county. On the south it is not so much covered, being visible in many of the small streams which empty into the river.

The *Frankfort slate*, with its thin layers of sandstone or rubblestone, rises upon the Utica slate, and shows a much greater breadth of surface, and is considerably exposed along the side-hill, also through Fulmer valley ; in parts of Steele's creek ; at Dygerts ; and in Myers' creek, back of Frankfort village especially. No fossils were seen in the rock, except some fucoids, probably attached to the sandstone, and a graptolite : these were from Myers' creek. It there shows high cliffs, with a slight dip south, the mass finally disappearing under the conglomerate below the furnace.

Throughout the county, the *Oneida conglomerate* appears resting immediately upon the Frankfort mass. It shows generally about an equal proportion of pebbles and sand. The lower part, towards the middle and west, exhibits about ten inches of pyrites, apparently cementing the pebbles. The mass is thicker at the west, than at the east end. It shows itself in a small terrace to the south of Mohawk village, from which the grey sandstone of the Clinton group is seen as a cliff above, forming a greater length of terrace than the conglomerate rock.

The *Clinton group*, like all the preceding masses, is well exposed in the many water courses which flow north to the river, the succession being well observed in many, and the parts also of which it is composed. This group, so important for its red fossiliferous ore beds, extends east and west through the county ; its surface in some parts more exposed than in others. It is a useful group in this county, containing an immense deposit of light grey sandstone, which shows itself at the east end of the county. It first appears at Crill's, extending thence with a constantly increasing thickness towards Myers' creek. Where thickest, it is about eighty feet. It is now used for lining the enlarged canal, being well fitted for walling, having numerous divisions which give the required size for ordinary building. No use is yet made of its ore, that of Verona being preferred. The discovery of gypsum, in the purest state in which this substance is known to exist in large masses, may prove of importance, and lead also to the discovery of other localities in the same position. The gypsum occurs in the upper layers of the grey sandstone, the second deposit of the east end of the Onondaga salt group covering the sandstone; and the adit by which the gypsum was obtained, is in part excavated in this mass. Throughout the county, the group is readily recognized in all the water courses south of the river, after passing the conglomerate; being between that rock and the red shale, which latter extends from the west to Crugar's, formerly Tisdale's saw-mill. From an unknown point to the east of the saw-mill, and west of the creek at Wicks' store, the red shale ends, and the next deposit of the Onondaga salt group takes its place, and extends east to near the Hudson.

The *Onondaga salt group* ranges parallel with the lower group and rocks through the county. Its lower mass, the red shale, terminates to the east of Crugar's saw-mill, although its thickness cannot be less at the mill than forty or fifty feet. The mass above, and which succeeds to it, consists of yellowish and drab layers by exposure, usually thin, some more or less earthy, and others solid. They, with the overlying Water-lime group, and other calcareous masses, have given rise to several deposits of tufa, which skirt the Clinton group in part. The first mass of tufa to the east, covers the hill-side east and west of Crill's: it is colored yellow by hydrate of iron. The next deposit is more considerable; it is in greatest amount near Mr. Field's distillery, and extends up to near the top of the hill. It is earthy and solid, some of which is in the state of alabaster, but the latter is in no great quantity; this deposit extends along the road by the side of the creek, for a mile and more. The third deposit of note is in Myers' creek, on the line of the red shale and the Clinton group; the lower part shows thin solid layers, very tough, and is burnt for lime and carried to Utica, making a very white lime; the part above, is the usual irregular deposit. There are other depositions along the range, but of small amount.

South of this group is the *Water-lime group*, whose range is readily traced from the hill to the south of Crill's; south of Mr. Crugar's house; Cedarville village; and the hill side on the farm of Edward S. Brown in Litchfield. This group furnishes good building stone for common purposes, and good lime; and though no water-lime is made in the county, if a demand existed, there is no reason why it should not be made.

The *Pentamerus limestone*, the *Catskill shaly limestone*, the *Cauda-galli grit*, the *Onondaga limestone*, and the *Corniferous limestone*, extend through the county; their surface in many places is covered with high east and west ridges of alluvion, particularly through the towns of Warren and Columbia. All information collected of these rocks were given under their respective heads.

The *Marcellus shales* underlie the soil of alluvion in the south part of the towns of Warren, Columbia, and the greater part of all Winfield. In Columbia, it is frequently met with upon the surface.

The *Limestone* or *Helderberg range*, as a ridge, maintains its integrity, or is unbroken through the county. The north and south waters divide upon its surface ; its southern slope, as well as the slope of the surface to the south, being very evident to the eye.

## 4. ONEIDA COUNTY.

This is a large county, embracing a greater number of different kinds of rocks than any other county in the district.

In commencing with the oldest, and terminating with the newest, the first in order is the Primary system of rocks. This system covers the northeast portion of the county, extending east from Black river, keeping on that side of the river, and extending thence by a straight line to Herkimer county, which it strikes about a mile or more northwest of the mouth of Black creek. The area formed by the county line and the line just mentioned, comprises those parts called Adgate, Woodhull, Remsen, and all that part of Boonville which lies east of the river. With the exception mainly of the border part along the river and its prolonged line, that area is yet uninhabited.

At the head of the feeder, is the settlement of Dr. Williams ; the rock is granite chiefly, and some of its varieties are very solid and beautiful. In blasting for the feeder, it was reported and asserted that coal was discovered in the solid part of a mass, and specimens were handed about. The part which the blast had left was well examined : there was no coal, nor mark of any in the rock ; no cavity or vein to enclose it, nor any fact to induce one to believe that it had there existed, save the assertion. The coal was pure anthracite, and in all respects the same which existed in the cavities of the calciferous sandrock of Little-Falls and Middleville. From the report having had some circulation, it is deemed proper to notice it ; the supposed discovery giving rise to great expectation of finding other and large deposits. It is difficult to appreciate the full value of what is certain or true ; but nothing adds so much to its importance, as the reflection that the world in which we are placed requires that all truth must be known ; for it is said, "the truth shall make you free." So we must know the truth ; therefore there can be no time for error, even ever so well intentioned.

The *Calciferous sandrock* no where exists in Oneida county, that I am aware of, except in the bed of the West-Canada creek, not far from the county line, where it is entirely covered with water. It may be found along the boundary of the Primary and the Trenton limestone, but was not seen in the part examined, nor heard of ; the discovery not being considered an object of importance, when comparatively there were so many of more consequence to the completion of the survey. It was not diligently sought for in the direction of the primary boundary line, as it ought to have been, as matter of fact and science.

The *Black river limestone* forms the bed of the river at Wheeler's mill, opposite to Boonville, and appears above the dam with the Trenton limestone proper, both appearing on both sides of the river. It is the only part of the county where that limestone was seen.

The *Trenton limestone* borders the Black river, from Lewis county ; extending southeast to West-Canada creek; covering a breadth of surface from three to four miles at the north, and increasing towards Remsen, its breadth towards Trenton village being about seven miles. It extends up the valley of Steuben creek, and along the valley of Beaver-meadow creek; the waters of the two creeks separated by alluvion, and flowing in opposite directions. Besides the parts so covered, it appears at Holland patent, and in the bottom of Lansing's kill, and a part of the Mohawk between the mouth of Beaver-meadow creek and the kill; also along West-Canada creek, from its junction with Steuben and Cincinnati creeks, to Herkimer county. Elsewhere it has no existence in the county. In all its great comparative range, it dips to the southwest, and under the Utica slate.

The most valuable part of the mass is the grey limestone, which is very abundant. Between Cincinnati bridge, above Trenton village and Boonville, it is the common surface rock. At Trenton falls it forms the upper part, being more observable on the west than the east side; also along the creek above Prospect. On the waters of Steuben creek, many quarries are opened in the grey variety, and also near the villages of Holland-patent and Stittsville. A low ridge of Utica slate separates the waters of Steuben creek from those of Nine-mile creek, covering the Trenton limestone between the two valleys.

The valley generally at Holland-patent is covered with the Utica slate, but not probably of any great thickness. About a mile from the village, near the road to Trenton village, is Nolton's quarry. The surface of the rock is much water-worn, parts removed, and the depressions filled with alluvion. It is in thick and irregular layers, of a light grey color, encrinal, and contains the Little-eared delthyris (D. microptera), Alternate strophomena (S. alternata), fragments of the Giant isotelus (I. gigas), etc. The valley spreads going towards Rome, and descends though rising upon a higher rock, from the dip of the limestone.

On Lansing kill, the limestone is confined to the bed of the creek, the high banks on both sides being covered by the Utica slate; the valley is narrow, the greater part of it being occupied by the bed of the kill. At ordinary times there is but little water in many parts of the kill, the water sinking into the fissures and sink-holes of the limestone. These are numerous along its course above the falls; and the stream, in its course, often disappears and reäppears. There are two falls, both over the limestone; the upper one estimated at seventy-five feet, the lower at fifty feet. Boulders of primary rock, which are numerous all over the surface near Boonville, are strung along the kill, showing one of the modes by which these masses have been carried from where first deposited as boulders. At the upper falls, there are a number which have been arrested at that place, waiting a stronger force to take them to a lower level and a greater distance.

The *Utica slate* covers a much larger surface, appearing to the west and south of the Trenton limestone in all its range, forming a thick overlying mass. It covers the greater part of the town of Steuben; the greater part of Floyd, of Deerfield, and a large portion of Trenton. It extends a short distance to the west of Boonville, and of Lansing's kill, the Frankfort slate having been seen in one or two places near the kill. It extends along the south border of the Mohawk to Herkimer county, appearing in the canal and in the creek at Utica, extending along the creek in the flat for some distance. It shows no change of character throughout, either mineral or fossil. It has been extensively washed away between the extension of Hasenclever hill and West-Canada creek, towards Trenton village.

The *Frankfort slate*, with its thin layers of sandstone, extends south and west from the outside border of the Utica slate, entering from Herkimer county, and passing out into Lewis at the west of Boonville. Within the border of the Utica slate, it covers the high hill in the town of Deerfield, a small area in Floyd, and the highest points of the Utica slate in Steuben. It forms the base of the first range of hills to the south of Utica, which disappear in the level towards Hampton. The boring near the village, and which has given rise to the Hampton springs, is in this rock. As before mentioned, this is the rock from whence the springs at Saratoga and Ballston issue, and in which the boring at Albany was made.

In Oneida county, going west, the two succeeding portions to the Frankfort rock appear, the whole constituting the Hudson river group : the lower one is first seen near Halleck's springs ; again at Whitall's quarry near Rome, and through Lee centre, etc. At Whitall's it shows more solid stone, but in layers too thin and too few in number to be of profit. The upper part, the sandstone shale of Pulaski, is first seen at Talcott's and Comstock's quarry to the southeast of Rome, and about a mile to the south of Whitall's. It doubtless commences further east, but buried under alluvion and soil. It is a good building stone at both these quarries, containing far more sandstone than is to be seen in any other part of its range, either in this county, Lewis or Oswego. This portion of the group extends over by Taberg village, its breadth greatly increasing north, extending over a surface of eight or nine miles, and narrowing the superficial space of the lower portions. Its fragments are numerous all over the surface of the west part of Boonville, Annsville, Taberg and Lee. It is readily recognized by its fossils, alreadily sufficiently made known.

Southwest of Talcott's and Comstock's quarries, about four miles from Rome, the *Grey sandstone* makes its first appearance west, and is quarried at Woodruff. It is of a light grey color, not in regular layers, and the upper portions much broken. Some pieces of the rock make good grindstones. Accretions of shale, usually bluish, often appear in the sandstone ; the same being common to the rock at Talcott's, and the red sandstone of Oswego county : the sandstone is quarried for Rome. There is a defect in parts of the rock, from the presence of pyrites, which decomposes and stains the stone of a yellow color.

The same rock appears in the road which leads from Rome to Verona, in its range to the northwest. It is not again seen until near Camden, from the covering of alluvion and swamps at the head of Oneida lake, which swamp extends to Rome. The Grey sandstone covers the whole of the town of Camden excepting the southwest portion, and the whole of Florence excepting a few patches of Red sandstone. It appears in numerous places in those two towns. It is not so light a grey as at Woodruff, and contains less sand, or more shale. Its color is somewhat greenish grey.

The *Red sandstone* appears in small amount, near the line of Oswego and Oneida. From the line of its direction in the former county, from its great breadth, the flat surface of the grey sandstone through the town of Camden and at Woodruff, it must extend east as far, if not beyond Woodruff ; the lines of its surface, as laid down upon the map, having been determined by the range of the Grey sandstone, and that of the Clinton group. Beyond these limits, it occurs in the village of Florence, on the rising ground to the north of the village, and near the town line of Camden on the road to Taberg.

*Oneida conglomerate.* This rock is coëxtensive with the county: its greatest thickness, too, is in this county; showing, however, in most of its locality, except its northern end, an outcrop in common with all the rocks above it. It occurs in Starch-factory creek; in the hill to the east of Utica; at the falls at the head of the gulph; in loose blocks in the hill southeast of Utica, and in place there also; at Mason quarry, at the point of the hill near New-Hartford centre; on Mr. Smart's farm, also near Wells', and to the south of New-Hartford; on the east side of the canal, about a mile below Clinton village; at David Mansfield's, to the south of Hampton village; near Oneida springs, and the stone pound to the northwest of Verona village. At these two latter places, there is the greatest extent of its surface exposition in the district.

The *Clinton group.* This group extends from Herkimer through the county, its breadth greatly increasing, west of the Chenango canal. It covers the surface of the first range of hills to the south of Utica, which diminishes west. It rests immediately upon the conglomerate, and therefore its lower boundary is readily determined. It is a valuable group in Oneida, containing the two beds of red fossiliferous iron ore, and is quarried in numerous places for its sandstone, all which were noticed under the group. Its ore must one day become an object of profitable exchange for the coal of Pennsylvania; for inasmuch as double the weight of coal is required to reduce a ton of ore to the metallic state, the ore will be carried where the coal is, and not the coal to the ore, so that the latter will be wanted for a return freight. There is no part of Pennsylvania that I have yet seen, especially in its northern region, which exhibits such extensive ranges of ore, and of so good a quality, as in this group; or where so great an extent exists with so little superincumbent materials, as in Oneida county. The first considerable exposition of the ore is on the hill to the south of Utica, at Wadsworth's diggings; the next, along the road from New-Hartford to Clinton; at Dr. Ruddock's quarry, and the various quarries, etc. to the west by north of Clinton village; in the neighborhood of Lairdsville; towards Westmoreland furnace and Verona. The best localities for the examination of the whole is in the creek by Rodgers' machine factory on the Sauquoit. When that is well examined, there is no difficulty in determining to what part of the group any of the apparent insulated parts or masses belong.

*Lockport group.* This group is but small in the county; but from where first noticed in Herkimer, it has gained considerably in its progress through Oneida. At the east end it exhibits but its outcrop, and but very little more appears in the side-hill; but in the town of Verona along Skanandoa creek, and that part of Verona which borders on Skanandoa village, its surface is exposed, the country being level. Its best point of exposition are Hart's, formerly Griffin's mill, on the east branch of the Oriskany; at Verona village, back of Turkey-street especially; and the neighborhood of Skanandoa. It is of interest from its concretionary character, its fossils, and being the extension of the group east of the Niagara Falls rock which disappears in Herkimer county. This group, which consists of dark impure limestone and bluish shale chiefly, is the interposed mass between the Clinton group and the Onondaga salt group. In the gully back of Dr. Noyes' house near Hamilton college, the group appears with the same associates as at Hart's mill. With the white carbonate of lime of the concretionary part, Dr. Noyes has found galena and blende ; a fact of some interest, as these ores also appear at Lockport and the Falls of Niagara ; and there is something like good evidence that this group is the rich lead-bearing rock of Iowa and Wisconsin, which is there of great thickness.

*Onondaga salt group*, consisting in this county of a thick mass of red shale, at the lower part of which there is some green shale ; the red shale uniform in its character, showing only some green spots, as may be seen near Vernon centre. The red is followed by drab, brownish and bluish layers, often irregular and thin, which change their color by exposure, assuming one or other of the former colors. It is very thick through Oriskany and Skanandoa valleys. From its calcareous composition, it will no doubt furnish abundance of water-lime. No gypsum in mass has as yet been discovered in it, but some small fibrous portions were found in digging wells, between Skanandoa and Oneida creeks, to the southwest of Vernon centre.

The *Helderberg range*, which is the same with the division of that name, leaving out the Onondaga salt group, consists in Oneida county of the Water-lime group, Pentamerus limestone, Catskill shaly limestone, Oriskany sandstone, Onondaga limestone and Corniferous limestone, and has been cut down by the Sauquoit, Oriskany, Skanandoa and Oneida creeks, exposing one or more of these different masses on the side-hills of the creeks where they traverse the range. The hills present points of their northern termination, capped with limestone, which, by the dip of the rock and rise of the valley, disappear under the valley about six to eight miles south of the northern line. The sides of the hills do not expose much of their rocks, from their gradual slope, being formed of alluvion, tufa and soil chiefly ; but occasionally a rock projects where steep, and appears in the brooks which descend from their summits.

At Cassville a quarry is opened in the corniferous, from which considerable stone has been taken out ; also on the east side of Bridgewater valley, where the same mass is exposed in the side-hill at Mr. Green's. Under this rock the Onondaga limestone appears, showing an unusual thickness, unless confounded with associated masses, from change in their mineral character, and the absence of their distinguishing fossils ; no quarry being opened, but all the stone there taken from the corniferous limestone above. The last point in the valley where the limestone appears, is in a sinkhole opposite to the Elm tree at Mr. Babcock's.

The ascent to Paris hill from Sauquoit valley, north of the Machine factory, shows the Water-lime group ; which is quarried below the brow of the hill. The corniferous is largely quarried for flagstone at Eastman's upon the same hill, on the road to Waterville, and the stone carried to Utica. The Onondaga limestone is quarried at a lower level for enclosures, the Oriskany sandstone appearing beneath it, and the latter rocks facing the valley of the Oriskany. At a lower level, and upon the side-hill, is Munger's old lime-kilns, where the Water-lime group is exposed for some distance, and also in other parts further north. The last point where the limestone appears as a ledge, is at the saw-mill near Waterville.

At Oriskany falls, the Water-lime group, the Pentamerus and the Catskill shaly limestone, with the Oriskany sandstone, are uncovered for some distance along the canal, and the surface of the hill on that side. It is the last point south, where these rocks appear in that valley.

When the demand for lime becomes considerable to the south, this hill will be of importance, from the rock being uncovered; from its great thickness, consisting of three distinct masses; and from having the Chenango canal at its side and end, the canal slightly bending at the end of the hill.

The Oriskany sandstone is better exposed at this locality, than in any other part of the State, resting upon the Catskill shaly limestone. In a loose specimen picked up, the Smooth atrypa (A. lævis), which occurs there in great abundance in some places, near the top of the Catskill shaly limestone, showed that the calcareous material of their envelope had been removed, or that it had ceased to be deposited when the sand was spread over them, being partly covered with sand. Not one of the species was found in the sandstone west of Otsego county.

The north end of the hill to the south of Hamilton College, shows the Water-lime group. It is the upper or surface rock of the hill, to within two or three miles of Oriskany falls, where the higher ones begin to appear, the highest seen being the Oriskany sandstone, and the western side being covered with alluvion.

The hill which rises between Skanandoa and Oneida creeks, rises to a greater height than those on the sides of the Oriskany creek; the former in places showing the whole series, with the Marcellus shales and a part of the Hamilton group. The best point for examination, is in the descent to Munsville from the village of Augusta. Several quarries are opened on the side of Oneida valley in the Water-lime group, the largest of which is to the north of the road, the stone having been extracted for the Chenango canal.

South of the ridge, and between some of its projecting points, as at Bridgewater flats, at Waterville, along the road to Cassville, etc, the *Marcellus shales* appear, being the first rock above the limestone. At Bridgewater, there are two or more diggings which were made for coal; and also one near Waterville; all which were noticed in the Annual Reports.

The *Hamilton group* is the next and last rock of the county; forming the highest elevations, rising upon the shales, and covering the greatest part of the town of Sangerfield and the hills of Bridgewater. Its particles are generally more coarse than the shales beneath; their color usually some shade of brown, and their fossils very different from each other.

## 5. Lewis County.

The geology of Lewis county is quite simple. It contains the three classes of products which belong to the district. The valley of Black river forms a perfect line of division between the Primary and the New-York system, dividing the county in about two equal portions; the primary covering the whole of the county lying east of the river, and the New-York system all that part of the county to the west of the river, with the exception of a few insulated patches or outliers which appear at the extreme north end of the county, resting upon the rocks of the Primary system.

Black river is an important feature of the county, being the chief outlet of its drainage, and forming the boundary between the well settled parts and that which is but thinly inhabited; its primary portion being, with some exceptions, like that of the district, yet a wilderness. The immediate valley of the Black river consists of the primary rocks, but they rarely extend more than a few hundred yards to the west of the river in any part of its course in the county.

The rocks which form the west side of the county, are the Black river limestone, Trenton limestone, Utica slate, Frankfort slate, sandstone shale of Pulaski, and the grey sandstone of Oswego. These rocks are arranged with great regularity. They form a series extending through the county, ranging nearly parallel with the river, rising one above the other in regular succession, the most ancient forming the margin of the river on the east, and the newest on the west. At the northern extremity of the county they all curve westwardly, their range in the county being northwest. The rocks which appear as outliers or insulated masses upon the primary, are the Potsdam sandstone and the fucoidal layers: the former was seen only near Lewisburg furnace and Harrisville, and the latter between the furnace and the Natural bridge.

The opposite sides of the river form the strongest contrast imaginable as to rocks, soil, vegetation and population. The surface of the east side consists, with few exceptions, of an almost unbroken range of forest, spread upon an uneven surface, the result of materials or masses first disturbed, and subsequently water-worn; no part of its surface in Lewis county presenting elevations of consequence, except near the southern part, where it joins to Oneida, and forms low mountain ridges. The western side of the river, on the contrary, is well settled, and exhibits those steps or terraces common to horizontal rocks or undisturbed mechanical deposits; presenting an almost unbroken outline, the lowest mass of which, the Black river limestone, rises and forms the west side of the river valley, either by the side or upon the primary, the junction no where perceived, and presents a cliff or mural precipice extending through the county. In no part of the whole of the division east of Black river, could I find or hear of a single rock that was not comprised in the Primary system, with the exceptions already mentioned; making it certain that the county is naturally divided, as before said, into two geological systems; the eastern formed of the rocks of the Primary, and the western of those of the New-York system.

This county admirably illustrates the connection which exists between rock, soil and population; the limestone and slate lands being well settled, and the primary comparatively unsettled. The difference is independent of temperature; for the whole of the north portion of Lewis, and that part which for miles borders upon the river, lies at a lower level than the land to the west; the former being unsettled, and the latter a well settled country.

From all observations made, the primary presents but few rocks, consisting chiefly of granite, and that peculiar kind of gneiss common to the west primary region of New-York. This kind of gneiss contains but little mica, and shows little tendency to decomposition, disintegration or alteration, and is therefore well fitted to be a good building stone as regards durability. The same remarks also apply to the granite, its associate. In the third district, these two rocks are of contemporaneous origin.

There are a few other aggregates met with in Lewis county, such as hornblende rock, but it is rare comparatively. From the boulders which are occasionally met with upon the west side, other rare aggregates exist, such as of coccolite and of tabular spar. These I met with but in one place in the county as fast rocks, namely, on the St. Lawrence turnpike about half way between Jefferson and St. Lawrence counties.

The surface of the whole of the Primary region slopes to the west, about as far north as Black river extends through the county; beyond that point or parallel, it slopes to the north, the northern part being much more level than the southern part. Where it joins to Oneida at the southeast, it is somewhat hilly and rugged.

Black river flows through the county upon an inclined plane, excepting at one point just below its junction with Moose river, where it falls sixty-three and a half feet over gneiss rock. From thence to Carthage, a distance of forty miles, the whole fall is but nine feet. Direction of the line of the mica, N. 55° E. Near the falls, is a vein of magnetic iron ore half an inch wide, ranging east-southeast, the only vein of the kind seen in the county. The same kind of ore was seen in the sands of several of the streams, and disseminated in the rock, but in too small a quantity to be of value; showing the source from whence the sand derived its ore, and the fact of its presence. The greatest surface exposed, containing iron of that kind, was at the falls of Moose river, at Lyonsdale; on the road, also, from the Natural bridge to Harrisville; and near to Lewisburg furnace.

The most important and interesting part of the Primary region, is the north extremity, extending from Lewisburg to Harrisville. The greater part of it is of Primary rock, but showing here and there a patch of more modern origin. Like the whole of the northern slope of the great Primary nucleus, limestone is somewhat abundant; it forms a part of its mass, and without doubt there is also an intermediate deposit of it to the Potsdam sandstone. The magnetic, specular and red oxide of iron, so common at the east end of the slope in the second district, are found at the northern part of Lewis, but none yet in that abundance which gives to these ores a commercial value. Why that part and the east slope should be so productive in minerals, and the south and the west so unproductive, there are no facts yet to determine.

The Primary limestone is found at the Natural bridge; the rock there projects from the bank, and a portion of the water of the creek passes through a fissure in the limestone under the road, giving origin to its name: it is associated with gneiss. The limestone appears on the farm of Mr. Wilber, not far from the bridge; and at another locality not far distant, where it was excavated for some extent in searching for lead ore, the rock containing plumbago. The limestone was seen in several places near Harrisville, and on the St. Lawrence turnpike, not far from the old toll-house. Wherever limestone exists in the third range of primary rocks, it generally presents numerous extraneous minerals; being more prolific of minerals in this range than in the others, and the most so of any of the rocks of the Primary class.

Specular iron ore is found in several places, associated with highly crystalline limestone. It exists near to Lewisburg furnace; on the land of Mr. Lafarge, near Harrisville; and in localities adjoining, which belong to the second district. When first discovered, there appeared to be a promise of abundance, but soon the spot was exhausted. It seems to have separated from the limestone by crystalline action, like gypsum and other minerals, being frequently enveloped by the limestone. Where found, it is but a superficial mass; and though its matrix is mixed in with primary rock, the origin of the two was subsequent to that rock, appearing to have been local deposits of calcareous marl and oxide of iron, similar to those met with in the gypseous region; the marl and oxide separating from each other by crystallization, being placed in a position which facts elsewhere prove was highly favorable to this operation.

That a deposit of iron was made upon the Primary rocks subsequent to their elevation and alteration of surface, is evident from the third deposit of iron ore, which, near Lewisburg furnace and in St. Lawrence county, is under the Potsdam sandstone, in places intermixing with the base or lower part of that rock; showing also at Lewisburg the same limestone and specular ore, the supposed associates of the Primary rocks, intermixed with the red ore; and thus proving a connection with the Potsdam, as intimate, if not more so, than could be discovered for the Primary mass.

Near the Natural bridge, on the land of Mr. Cleaveland, there is a considerable deposit of plumbago in small particles, much mixed with the rock. Where the particles of the rock are large enough to be seen, they show that it is composed of chlorite, idocrase, quartz and probably feldspar, the latter not recognized; and more rarely minute scales of red oxide of iron, which in one specimen formed a vein as to form, of a quarter of an inch in thickness. The deposit has given rise to some little excitement, from a belief that it was a silver ore. Associated with the plumbago rock, there are others which were noticed in St. Lawrence, probably of similar composition; some containing pyrites in cubes, and a peculiar white fibrous and cellular mass with plumbago, never before seen excepting between the ore beds of Parrish and Kearney near Somerville. In the rear of the deposit, are the usual gneiss and granite rocks; but the whole of the former products appear to be referable to the Taconic or Intermediate period of the Primary and the Potsdam sandstone.

The *Potsdam sandstone* forms two low short ridges on the Lewisburg furnace tract, and one near Harrisville. It appears in all three ridges with the same characters as at Potsdam, and equally valuable for ordinary building and for the lining of furnaces. Besides its utility for such purposes, it is an important rock in that section; for under it, and upon the Primary rock, the specular and red oxide of iron were deposited, such being the position of these ores; and whatever ore the rock covered, must there exist. It is certain that ore exists under the two ridges near the furnace, but the quantity is yet to be determined.

The fucoidal layers of the Calciferous group were seen on the road from the furnace to the Natural bridge, and from the bridge to Carthage, the latter locality being in Jefferson county. The rock appears there with the same characters as on the Mohawk, and the Calciferous sandrock proper was not seen in any part of that section.

Rising and going west from the primary which skirts Black river, the first range of rock is the *Black river limestone,* forming a terrace coëxtensive with the county. It is its most valuable rock for building, and for lime, of which there are two kinds, the common and the water-lime. The upper layers of the terrace are those which are intermediate to the Trenton and the Birdseye limestone ; those below belong to the latter rock, and are the most valuable for building, and burning for lime, being more solid and pure. The part used for water-lime is under the layers which are usually quarried, and where seen, was a yellowish color, and somewhat dull as to reflection of light. It was noticed only at the following localities : First, near the mouth of Sugar river, at the quarries ; then to the east of Collinsville ; and near Lowville. It is no doubt coëxtensive with the cliff or terrace. The test of a water-lime, for all practical purposes, is very simple. When the stone is calcined or burnt, it must not slake ; and when ground and made into mortar, it must set and harden under water. It may be well to remark, that generally less heat is required to burn this kind of limestone for the purpose required, than to make ordinary lime.

The *Trenton limestone* is the next rock in succession, rising upon the Black river limestone, and showing a thickness of three hundred feet at its north end, but appearing to be less at its south end. Its greatest known thickness is in this county. It ranges like the lower limestone along the river, curving north, exposing a surface from two to four miles broad ; in some parts rising rapidly from the lower terrace, in others by a gentle slope. From its great thickness, it exhibits many fine water-falls yet unknown to fame, the greatest of which is near Copenhagen ; and another is on Deer river, falling two hundred and seventy feet perpendicular depth from towards the upper part of the rock.

The Trenton limestone underlies the villages of Collinsville, Martinsburgh, Lowville, Denmark and Copenhagen. It varies considerably in quality : in some places, greyish and crystalline ; in others, more generally dark-colored, the separations of shale thick, and the limestone frequently assuming an accretionary character from admixture of shale. It is a metalliferous rock, galena having been found in it at three places, but not in profitable quantity as yet. The first place where seen going north, is near Ives' mill, on the road from Shelden's to Collinsville, some particles being found in the quarry at the creek ; but it is more abundant at Lowville, associated with other ores which were worked as silver. It is in considerable quantity at Martinsburgh, but in veins too narrow to be worked with advantage under the existing state of things. The rock appears near the surface at the highest point to the northwest of the village. The veins are very numerous, and occupy the vertical east and west joints of the rock ; continuous as to direction, both vertically and according to their east and west points, but often interrupted for want of continuity in the joints. The ore is accompanied by blende, and by what appears to be calamine, in which the galena often presents a beautiful feathery form of crystallization. The stony materials are white crystalline carbonate of lime. The joints are from zero to eight or more inches in diameter, ranging in parallels but a few feet from each other ; their character is unknown beyond a few feet from the surface, the greatest depth attained being but fifty feet, and the thickness of the rock at that place, as previously mentioned, being about five times that depth.

At Lowville, the ore exists in the joints of the rock; and the fact of its existence in the body of the limestone at Martinsburgh, is a further proof of the truth of the view of the origin of veins, set forth in the first report of the survey of the fourth district, namely, a connection between the rock and the vein, one being the source of the materials, and the other the recipient or place of reception or deposit. The facts at these deposits show clearly that the whole of the materials were originally deposited together; then followed that degree of solidity necessary to produce cracks or fissures, caused by contraction either from cooling or drying, or fracture from disturbance; the contraction being the more probable cause, without doubt, of the jointed structure of rocks, from their almost universality. After this action as in septaria, a movement of the crystalline particles to the fissures took place, in virtue of the great surface of the joints presenting a mass of attraction to the moving particles, which is necessary in crystallization as is well known. The cause of the preference of the metallic particles for the east and west joints, is yet obscure. It is connected in all probability with the motion of the earth upon its axis; and were the connection, which undoubtedly exists, between electrical and centrifugal forces established, the cause would be known; for the metallic particles, in that case, would be moved by that power which had for them the greatest attraction.

The *Utica slate*, as in all its other localities, rests upon the Trenton limestone, rising by a gentle slope comparatively, and forming the base of the high grounds which extend along the whole of the west side of the limestone range. It is from one to three miles broad, presenting the same characters, mineral and fossil, as in the other counties. It appears in all the creeks, showing generally high walls or banks, the result of the destroying action of concentrated waters. It curves rapidly to the north beyond Copenhagen, near to which, up Deer river, it appears. The slate, to the south of Martinsburgh, ranges for some miles parallel with the stage road to Rome, keeping within a quarter of a mile to the west of the road as far as the fork to Constableville, where it diverges more to the west from that road. Its range through the county is in a northwest direction, like those of the lower rocks.

The *Frankfort slate*, and its thin layers of sandstone, follow the Utica slate, no line of demarkation being evident. At the south end of the county, it is about four miles west of Black river; passes by Constableville, advancing or receding from the river, as the hill of Utica slate, which commences upon the Trenton limestone, rises or falls; farther removed from the river where low, nearer where high. The sandstone shale of Pulaski follows it, being only distinguished by its fossils; the two masses forming a belt of from seven to ten miles wide, and broader at the extremities than in the centre. It is the mass upon which the waters divide east and west. The population diminishes going west from the range, the soil diminishing in fertility as it recedes from the limestone border. This outline of the elevated part is level.

The *Grey sandstone* covers the residue of the county, being the southwest portion. The whole of it is yet but little inhabited, being covered with forest, and presenting an inclined surface to the west: all the inequalities of its surface are produced by the drainage of its present and former flow of waters.

*Quaternary class.* The ordinary products of alluvion were found upon the surface of the greater part of the county on the west of the river, but no deposit requiring to be especially mentioned. Boulders large and small, and other forms of primary rock, were found in numerous parts, indicating a general and not a local cause of their distribution. The yellow sand was in great part, if not wholly, confined to the valley of Black river. The only considerable deposit seen of clay that was thick, was at the lower locks above the falls on the river, and along the line of the feeder; at all other localities, the deposits appeared to be quite superficial.

The country west of Black river, through Lewis and Oneida counties, exhibits perfectly, upon a smaller scale, the same erosive action which took place to the south of the Mohawk valley, extending along the whole of the Helderberg range. The same causes have operated alike in both sections of the district, the difference being merely in the magnitude and direction of the action, and the kind of rocks. The resemblance between the general features of the two sections is very striking: A deep valley traverses each in parallel directions, in which clay and sand were deposited; boulders and other rolled stones of the Primary system are diffused over the entire surface of each, from the lowest to the highest points; and the high range in each section faces the Primary region, having a deep and broad valley at its foot, with a system of lesser valleys transverse to the great one.

## 6. Oswego County.

The whole of the county presents but four rocks or groups, each occupying a well defined portion of the county: its geology is therefore very simple. The oldest mass is to the northwest of the county, and the newest upon the southern border.

The first or lowest are the *sandstone shales of Pulaski*, which are confined to the towns of Sandy-Creek, Pulaski, the northern part of Richland, the northwest corners of Albion and Orwell, and the west side of Boylston. Its surface is one of denudation, the succeeding rocks having at no remote period extended over it. It is the most valuable of all its masses as regards soil; the shale itself forms a good soil, and parts are highly calcareous, as at Pulaski village; and from the specimen found on Lake Erie, it also contains some good limestone, though none was met with in this district.

The *Grey sandstone* overlies it to the east, extending into Lewis county, and to the south, covering the whole of the space north of a line which commences near the north waters of Little river, and passes a little to the north of Amboy centre; the line slightly curving to Mexicoville and Butterfly post-office, and from the latter village passing on an east and west line by the south side of Oswego village to the lake. This rock contains good building stone, and grindstones; the latter quarried near Salmon-river falls in the town of Orwell.

The *Red sandstone* is the third rock of the county. It is coëxtensive with the Grey sandstone, resting upon it in its order of succession, and covering the remaining south portion of the county, with the exception of a strip extending along its south border; it is narrow at the east end, and broader at the west end, which is occupied by the Clinton group, the latter forming the last and the most southern mass of the county.

Besides the large area covered by the Red sandstone, it appears as an outlier or insulated mass to the northeast of Redfield village, on the east side of Mad river.

The Red sandstone is the lowest rock of that section of the State, which contains brine springs. They are found from place to place, from the east to the west end of its range in the State. By boring, salt water no doubt could be obtained below many parts of its surface. The localities where it makes its appearance in the county, are in the town of Palermo, on the land of George G. Grizzle; and in the town of Hastings, at Mr. Kenyon's. The red sandstone is, in many parts of this county, a good building stone, and valuable as a lining for furnaces.

*Clinton group.* Very little of this group is seen in the county, being thickly covered in most places by alluvion, concealing the group; its position is determined by its range in Oneida and Cayuga counties, and its shale appears on the south side of the outlet of Oneida lake, and at a few other points near its river.

In no part of the county, was the Oneida conglomerate seen as a solid rock or mass; but that it had existence in the county, appears obvious from the great number of blocks of this rock to the east of Cleveland, along the shore, and to the left of the road towards Rome.

The surface of the county is free from high hills, and generally level. The most elevated portions lie towards the northeast, with the surface inclining south and east, and the drains mostly emptying into Salmon river, whose course is nearly east and west in the county, being north of the long water shed that ranges through it.

From Oneida county to Oswego river near Fulton, the surface of the county inclines in opposite directions: about one half sloping to the north, with its waters flowing into Lake Ontario; and the other half to the south, its waters passing into Oneida lake and its river. The difference of level between the two lakes being 141½ feet, gives a greater declivity to the northern slope.

Like all the counties to the south of Lake Ontario, and north of the Helderberg range, its surface is more or less covered with alluvion, consisting of clay, loam, sand and gravel, either diffused over its surface, or disposed in hills and ridges. From the profusion of these materials, very little soil is to be seen which is the result of its rocks in place, the greater part being transported matter. Where soil from the decomposition of the rock in place appears, it is in limited areas or patches; appearing to be more abundant in that part of the county covered with the sandstone shale of Pulaski, than any other portion of it.

## 7. MADISON COUNTY.

The northern part of this county is low and flat, forming a part of the Great level, which enters from Oneida with the same rocks, and to which a large proportion of the red shale is added, thereby increasing the breadth of the level, and the group to which it belongs. The gypseous hills rise at the south upon the red shale, with their surface more or less rounded, and extend to the foot of the Limestone or Helderberg range. The edge of the range shows an elevation of over one hundred feet above the gypseous rocks. The surface rises to the south by every additional rock, the whole of the rocks of the county going from Lake Oneida south, and showing the order of their superposition; the lowest being at the lake, the highest at the south of the county, and the intermediate ones occupying the intervening space.

Between the ridge and the lake, the *Clinton group*, the *Niagara group* and the *Onondaga salt group* occur, the first being the lowest mass of the county. It borders the lake, with the exception probably of a small part to the west of Joscelin's corners, where the second group by a prolonged line would appear. It shows the red fossiliferous iron ore, the most important product of the group, in two places, and in quantity; the ore being found on Donnelly's farm at the east end of Lenox, and at Joscelin's corners, of which sufficient detail was given under the head of the group. There are indications of the same ore at Munger's post-office on the lake shore, and also at Robert Bushnell's. At this latter place, there is the hard sandstone of the group, in part calcareous and encrinal, and suitable for building purposes.

To the south, the *Lockport group* extends east and west, and disappears at its south side under the Cowasolon swamp. It is composed of blackish colored limestone, usually with a highly crystalline grain resembling fine sand, and bluish colored shaly slate. It appears generally as a low ridge between the lake and the swamp, often covered with gravel. The limestone shows itself at the surface on the farms of Joseph Clark and Enos Hubard in Sullivan, and Capt. Hood and Mr. Adams in Lenox, etc. No fossils were noticed in it. It makes a strong lime, but is of a dark color, owing to iron and manganese. It is the highest rock as to level of all that section, and appears to have escaped destruction by its hardness.

Between the gypseous hills and the lake, there appear to be a series of low ridges, sandy, gravelly and loamy, whose course is somewhat east and west, or parallel with the lake. Between those ridges, the soil is more or less clayey, usually yellowish, and forming a considerable portion of the swampy surface of that section of the county. The clay, from its color, appears to have been derived from the shale of the Clinton group.

Cowasolon swamp forms a part of the same space: it occupies an area of about ten thousand acres, nearly the whole of which, it appears, can be drained. Before any drainage was commenced, it was covered with muck or peat, under which lake marl appears in all places examined. An attempt was made to drain the swamp, by cutting a ditch to the lake. The ditch was fourteen feet deep, and carried off a large portion of the water, and uncovered the marl to great extent, which was very pure and white, strongly contrasting with the muck. Though no particular examination was made, it was evident from the velocity of the water at the drain, that it could be deepened.

Were a good system of drainage established, a large body of land could be brought under cultivation, which now lies worse than useless, along the low level, extending from Rome to the fourth district. To the acquisition of good land would be added that of a plentiful supply of lake marl, which, if properly hardened by drying, could be prepared for chalk, whiting and paris white, and for lime and agricultural purposes; to say nothing of the muck, of which each year's experience is enhancing the value as a manure, its greatest benefit accruing when carted and spread in the farm yard. It compensates the farmer if used without any preparation, but still better when mixed with the lake marl, which, in the low swampy regions north of the gypsum hill, it so frequently covers.

South of the swamp is the Vlie or Natural meadow, the extent of which I did not ascertain. The growth of timber diminishes going to it, ending in scrubby tamarisk, dead trees of the same being numerous; after which are ferns, other weeds, some grass, etc. The soil of the vlie is muck, or peat very pure. A ditch cut by the side of the road leading to it from Chittenango, shows vertical stumps three feet below the surface, and then a small growth near the surface; so that it would appear that two forests have existed there. A little marl appears amongst the muck. The road showed, where some oats and timothy seed had been scattered, the favorableness of the soil for vegetation.

The swamp occupies a depression between the Lockport group and the Onondaga salt group, concealing the junction of the two throughout the county. To the south of the swamp is the red shale, the canal passing through the surface which it covers, and the shale extending a little to the south of the turnpike from the east end of the county to near Chittenango village. It shows, in the low grounds to the north of Chittenango, some of the light-colored calcareous portions in layers; but the greatest exposition of alternate colored layers is in the hills to the east of the county, and south of the turnpike; another is at Canaseraga creek, and a third at Chittenango hill.

Near Canastota, there is a salt spring in the marsh on the land of Captain Clark, about thirty yards north of the canal. A boring was here made of one hundred and ninety feet in red shale, and six feet in hard green rock. This latter depth took several days to perforate; at the end of which time, it was said that a portion of the auger broke, and could not be extracted. When commenced, the strength of the water was $2\frac{1}{2}°$ by the instrument used, and increased to 9°. Having been abandoned, it is reasonable to suppose that there was no encouragement for a further prosecution of the work, especially when so near to known sources of great strength as at Syracuse, &c.

The hill rises to the south about eighty feet at the village of Lenox, showing green and dove-colored shale and slate; to the south of which, there is a further rise of near one hundred and fifty feet, showing alternations of red and green, etc. to the top.

The value and interest of the group is in that portion which contains the gypseous masses; and these, in every instance in the range of the group, are above the point where all red shale ceases, and consequently to the south of the turnpike road. The greatest breadth of the range containing gypsum is at the east end of the county; diminishing greatly to the west end. It is exposed in many places on the east branch of the Cowasolon creek, on the west branch near Clockville, and along the road from that village towards Chittenango; the details of which were given in the group, and in the Report of 1839.

The *vermicular* or *porous rock*, is well exposed in the high hill at the east end of the county; in the road which leads from the furnace towards Clockville; and at the quarries near the road which leads to Chittenango. At most of the quarries and places the hopper cavities are also found, the most numerous at Bull's quarry.

On the Cowasolon creek, below the furnace, there is a sulphur spring, and two other quite copious ones on the creek near Chittenango; all which flow from the third deposit of the salt group.

The *Helderberg* or *Limestone range* forms, with the Onondaga salt group, the high hill which projects north between Oneida creek and the east branch of the Cowasolon. The northern end shows the salt group, the higher rocks or limestone appearing going south. Where Oneida creek turns to the west, are the falls of the creek, showing an interesting section, the water flowing through an excavation in the Marcellus shales, and descending by the Seneca limestone, the Corniferous, Onondaga, Pentamerus limestone and the Water-lime group, over which latter are the highest falls. The layer with diagonal divisions or cracks exists there, and is burnt for lime: it is over six feet thick; and under it is a layer of water-lime, between two and three feet thick. The Water-lime group is well exposed along the north side of the creek, for some distance; south, it is soon lost from the rise of the valley, and the abundance of soil which covers the side-hill.

This is the last point to the west where the *Pentamerus limestone* and the *Catskill shaly limestone* were distinctly recognized, the whole thickness of the two within twenty feet. It is the first place going west, where the Seneca limestone with the Strophomena lineata appears; and also the first point, moving in the same direction, where the impure black shaly limestone with goniatites, orthoceræ, etc. is seen, which terminates the interrupted layers of the lower part of the Marcellus shales; the thickness of the mass being about two and a half feet or more, usually divided into two layers.

The Limestone range passes to the south and east of Siloam, curving towards Perryville; to the east of which, under the Onondaga limestone, and forming a part of the Oriskany sandstone, is the locality of arenaceous and jaspery iron ore. The limestone is exposed in the terrace to some extent; and shows, by the width of its vertical joints, that water had flowed over its surface: this locality is on the farm of Mr. Vannep.

At Perryville there is a fine fall of water, the creek flowing over the Onondaga limestone, and falling from a height computed to be about one hundred and twenty feet, the gulf beneath being excavated in the Water-lime group. Some of the layers of the Onondaga contain flint in nodules, which destroys its good qualities for lime and for masonry, other than rough or common work.

The falls on Chittenango creek, usually known by the name of Cazenovia falls, are over the same series of rocks, showing also the corniferous which forms the sides of the creek at the top of the falls. The upper part of this rock is in solid layers, with its usual nodules of flint; under which there is about two and a half feet of thin shaly layers of an ash green color, similar to a mass at Auburn, which holds the same position, and which is part of the corniferous rock. Below this is the Onondaga, over which the water falls, containing flint towards its lower part. At the bottom of that rock there is about six inches of the Oriskany sandstone, but variable, which is hard, yellowish, greenish and blackish, with a few of its usual fossils. Under the Oriskany sandstone there is a dark fetid limestone, which appears to belong to the Pentamerus limestone. It contains fossils, but those obtained were in fragments, and their kind not satisfactorily ascertained. It is quite a thin mass, not much over a foot thick. Under it are layers of the Water-lime group, which extend to the bottom of the falls. The falls are said to be one hundred and thirty feet in height. At about a third of the height from the top, there is a shelf which projects from the base, below which is a thick layer with oblique divisions; under which is a much thicker one, composed of thin straight courses, followed by another of like size with irregular divisions; this latter extends to the bottom of the falls. In this lower part the Orthis plicata is quite numerous.

The creek above the falls flows from the south, through a small handsome valley; its lower sides are formed of the Marcellus shales, whilst the top of the hills on both sides consist of the Hamilton group.

The Onondaga limestone is quarried for door frames, and other hewn work, on the east side of the creek below the falls. On the west side much more is exposed, the road passing over its surface at the top of the hill, and extending down the creek to near Chittenango. Between the creek and the limestone quarry to the south of the village, this rock and the Water-lime group show a cliff, which is partly concealed by forest trees. At the quarry are the two layers of water-lime, which are burnt for cement. The top of the Water-lime group is covered with the Onondaga limestone; at the bottom of which, in a few points, are some grains of sand, and a few black nodules which belong to the Oriskany sandstone, with nothing else intervening. As the cliff here can be well examined, it is evident that all the rocks which at the east are intermediate to the sandstone and the Water-lime group, have come to their end.

The best exposition of the Marcellus shales, being the mass which rests upon the limestone ridge, is at the falls on Oneida creek, extending from Foster's grist-mill to the saw-mill, where are also two excavations for coal. The shale is seen in numerous other places along its line, which in a few points approaches near the edge of the limestone ridge. At Sage's, south of Chittenango village, the mass is well seen, but not much of its interior, facing the hill upon which the Hamilton group rests, and which extends south: at this place also a boring was made for coal. More of the interior of the mass may be seen on the farm of Peter Robertson, showing the imperfect layers of the lower part, some of which approach to septaria.

Where the shales rest upon the limestone, between the quarry back of Chittenango and the road to Eagle, there is a spring of water about twenty feet over, and of considerable depth; the water enters and disappears by unknown cavities, and it appears to be a *sink-hole*.

The *Hamilton group* covers about one half of the county, and, as usual with all those overlying rocks on the south side of the Limestone range, it forms the surface mass of the whole of Brookfield, excepting a small projection of the Ithaca group at the southwest end; of all Hamilton, Madison, the east half of Lebanon, three-fourths of Eaton, the south part of New-

Stockbridge and Smithfield, all but a small portion of the northern part of Fenner, the greater part of Cazenovia, and the middle northern part of De Ruyter. The greater part of the mass consists of hard coarse bluish shale, in parts calcareous: a considerable portion of it does not disintegrate when exposed to the weather, but exhibits innumerable divisions which produce no determinate forms; the longest side, however, is the horizontal one. This is the kind so abundant in many parts of Brookfield, East-Hamilton, Madison, Eaton, Fenner and Cazenovia. It is usually highly fossiliferous, and is the common building material. The sandstone portion of the group is rare; but little being seen beyond the valley of the Chenango canal, from about the hills near Peck's basin to Chenango county. Its greatest line of exposition is from the hill back of the Seminary at West-Hamilton, to Ladd's quarry by the side of the canal near the county line. The softer parts of the group, so abundant further west, are not seen in great mass; owing probably to the soil covering the side-hills, and to a greater amount of the harder shale.

The soil of this group is superior to that of any of the higher groups, owing to a greater amount of finer particles, and more carbonate of lime. The hill sides slope gradually, and are generally covered with soil, the rocks only occasionally appearing.

There are no extensive quarries in the group opened, except at West-Hamilton on the Seminary hill, and at Ladd's to the south. Considerable rock was excavated in making the feeder by the side of the hill near Hamilton village, consisting of the coarse variety of shale.

The hill at the seminary is the most favorable point for the examination of the group as it appears in the county, beginning at the small quarry near the road-side below the boarding house, and ascending thence by the brook and the middle quarry to the upper one. The same series in part are also to be seen at Deacon Burchard's, where fossils are far more abundant.

The low hill-side to the south and east of Woodstock, shows the same sandstone and fossils as at Hamilton, and the stone is quarried.

The valley through which the Chenango canal passes, is the most interesting feature of the surface of the group. It drains at present a large portion of the group, and at one period, from its breadth and its connection with Oneida and Oriskany valleys, was a large water course. Its flat bottom, composed for a depth unknown of alluvion, gives it the appearance of having been a lake, after its excavation had ceased, and alluvial materials were poured into it. The ponds which yet remain in it, are evidences of its former nature; such as Woodman's or the Long pond, and Leland's pond, with one below and another above it.

The valley of Woodstock is excavated in the same part of the group, but not to so great a depth in the group, except at the south end of the county. In digging a ditch back of Benjamin F. Burgess' shop at the village, the tooth of an elephant was discovered as before noticed; the ground is a swamp, covered with about two feet of muck, under which is yellow clay; the tooth was nearly buried in the clay, and it showed no marks whatever of transportation. Facts of this kind are important; for the possession of a few fragmentary relics, such as the bones or teeth of an ancient race of animals, enables us to determine the condition of the surface of the earth when they formed a portion of its inhabitants.

The remaining rocks and groups of Madison county, are the *Tully limestone*, the *Genesee slate* and the *Ithaca group*. These occupy the projecting parts, extending from the southwest part of the county, embracing all Georgetown, all but the northwest and northeast corner of Nelson, the west of Lebanon, the southwest part of Eaton, the southeast portion of Cazenovia, and that part of De Ruyter not covered by the lower group. Beside these, there is also another projection at the southwest of Brookfield.

The Tully limestone no doubt extends through De Ruyter, from its thickness near the town line, and from its appearance on the turnpike between that village and Smyrna.

The Genesee slate underlies the village of De Ruyter, appearing in the hill-sides and along the road to Smyrna for some distance, either alone, or with the base of the Ithaca group resting upon it. The shale also appears in its range through Lebanon, &c. &c.

The Ithaca, including the Portage group, presented but little interest in the county generally. It is a more useful rock than the group below it, because it contains more materials of sandstone for building, but it produces an inferior soil. The most northern part where it was seen, was at Smith's saw-mill, to the east of Nelson's flats, where a mass of about eight feet shows itself, being a light bluish sandstone, which becomes yellow by exposure to the air: it breaks with a curved fracture, the result of a concretionary structure. It rests upon a black shale or slate. Very little rock is exposed upon the side-hill, the surface between there and Peterboro' being apparently not very elevated, and its outlines having the form of alternate depressions and swells. A rather better exposition is on the road from Cazenovia to New-Woodstock, near the mill-dam on the creek. It shows thin layers of sandstone, straight and waved, with slate and shale, and a few fossils.

The hill-side below Woodstock, on the road to De Ruyter, shows a gravel plane, which inclines south, rising about one hundred feet above the road, and plainly exhibiting at that level an ancient water-course. It continues from hill to hill, for some distance maintaining about the same elevation above the valley.

About a mile and a quarter to the south of east of the village of De Ruyter, is Burdick quarry, from whence stone was taken for the academy. It is near the top of the hill, and appertains to the Ithaca group. The *Curtain-like* and the *Retort-shaped fucoids* were found in this quarry, as has been before stated and figured.

## 8. ONONDAGA COUNTY.

This is the most valuable county of the district for the products of its subsoil, such as salt, gypsum, water-lime, limestone, etc. Its rocks range east and west, the order of succession being well observed; one rising upon the other, the lowest being at the north end of the county, and the highest and newest at the south end. The county is very nearly divided by the limestone ridge; the greater part of the northern half forming a part of the Great level, into which the Cowasolon swamp from Madison extends, and the Seneca river from Cayuga: the latter joins the outlet of Onondaga lake.

The oldest, and therefore geologically the lowest of its rock series, is the *Clinton group*. But little is exposed, from the flat nature of the country where it is found; ranging along the south shore of Oneida lake, and extending into Oswego county, its south line being near the Three-river point. At the village of Brewerton, its greenish and bluish shales may be seen in the road-side, and in the bank of the outlet, and at the mill below. More information can now be obtained, since the appropriation made by the State for deepening the river at the rifts; the depth of water being too great when visited, to examine their rocks.

The *Lockport group* is the second observable deposit; it extends through the county with an increasing breadth of surface from Madison. Its lowest point south, at the east of the county, is at Bridgeport, also called the Rift, from a ledge of the limestone which appears in the bottom of the creek. In the town of Cicero, the limestone is quarried at White's, about two miles from the Rift. At Whiting's, about two miles from Cicero corners, it is exposed over an extent of about fifteen acres; but not more than four or five feet of thickness is seen. The first layer is fourteen inches thick, imperfectly subdivided into two courses, and contains some small cavities. The layers below are respectively seven, three and four inches, and the bottom of the quarry is composed of very thin layers or slates. Between Cicero village and the outlet, at Lukin Denis', are the best specimens of the concretionary limestone; layers thin and protuberances numerous, showing the rounded elevations and depressions so characteristic of the limestone of this group.

In Lysander, there are several quarries opened in the group, two of which are near to each other: Ham's and Bigelow's, on the road from Baldwinsville to the falls at Fulton. About five feet of rock are quarried.

Near Betts' corner, is the quarry of Aaron Vedder; the layers are more straight and thick than any to the east. There are curved layers at the top, and straight ones below. They make a good and a white lime.

This group, for its limestone, is a valuable rock for that section of the country where rock is scarce, and lime is wanted for building, and for its light soils, some of which are sandy, alluvial products being abundant all over that section.

*Onondaga salt group*. This important group covers a large portion of the level, the red shale or lower part ranging to the north of the canal, with small exceptions; and the whole of the gypseous portion, with like exceptions, being to the south of the canal: the former or red shale portion generally lies low and level, but the latter rises into moderate hills, and passes under the limestone range at the south. The greatest breadth of the red shale appears in the town of Van Buren, showing itself along the canal between Jordan, Canton and Amboy, and to the north of Seneca river, on both sides of the village at Baldwinsville. Its northern range is covered up in Clay and Cicero, by the great swamp and alluvial which extends from Madison towards the outlet of Onondaga lake. The whole of this portion of the group, which is of great thickness in the county, its maximum being over five hundred feet, is as yet unproductive of any valuable mineral. The greater part of the surface portion of Onondaga lake is excavated in the red shale, the lower part of the whole of it extending considerably into its mass. Such also must be the case with Sodom lake, from its depth of one hundred and sixty-eight feet.

The space occupied by the gypseous portion of the deposit, is from about three to four miles broad; the villages of Hartsville, Fayetteville, Orville, Camillus and Elbridge being placed near the line of its centre. Within the space containing the gypseous masses, we find the whole of the porous or vermicular limestone, the salt cavities or hoppers, and the fibrous cavities caused by sulphate of magnesia. Very little gypsum is quarried at the west end of the county, the quarries being opened chiefly in the towns of Manlius and De Witt; not that the west part is not productive in this mineral, the grading of the railroad along Nine-mile creek proving it to be equally if not more so than the east end. From the great size of the masses upon Cayuga lake near Springport, the quantity of gypsum is either greater west, which no fact noticed in the fourth district proves; or what is more probable, the maximum quantity is to the south of its northern outcrop. Should such be the case, from the association of rock salt with gypsum, any boring for the former, independent of the facts heretofore made known, should be south, and in accordance with the range of the greatest deposit of plaster.

The porous or vermicular limestone is greatest in amount in this district, forming two distinct deposits: the upper, which is the same with that in Madison county, the average thickness of which is about four feet. In that county it appears to be continuous as to mass, as well as holding the same position. In Onondaga, no attempt was made to ascertain if it is continuous or not; but its position is fixed, being placed above the first series of plaster masses, and above the hopper cavities. It is well exposed in the hill at the Foot-street road near Syracuse, and also on the road which leads from the turnpike to Bellisle; but better on Nine-mile creek, between the turnpike and the embankment, in the hill-side above the railroad. The pores of the upper mass are generally large, though also small; in which latter case, they are not to be distinguished from those of the lower, the material being the same in composition and color.

The lower mass, at the two localities where it is best exhibited, is about twenty feet thick, its pores small and color brown, though it is likely that this color in both masses is the effect of alteration, its porous nature readily admitting of a change even though not exposed to the surface, and its original color appearing to have been a dark blue. On the road from the turnpike to Bellisle, the interposed masses to the two porous rocks are similar to those below the upper one in Madison, and contains also the same fossil shells as at Bull's quarry.

At Syracuse, in the Foot-street road, the thickness of the lower porous rock is about the same; some of the intervening parts are also of the same kind with those of the former localities, but with other products having a crystalline character, being serpentines; the action of crystallization having operated powerfully, though locally, producing mica and even nodules of granite, or rather sienite. It is not necessary to suppose that any great degree of heat has here existed to produce these bodies; nothing more being required, than that their elements should be set free from lime, magnesia or any other soluble earth, so that their particles could come together. A thermal heat would be ample, especially if accompanied by pressure, which greatly favors combinations of all kinds.

Between the two porous masses through the three gypseous counties, are the hopper cavities, one of the most interest relics of the group, showing that salt in a solid and crystalline state existed in the group, and its position in the group. From the large size of some of the hoppers, exceeding three inches in diameter, they could not have been formed upon the surface of water, since in the evaporating troughs they rarely exceed half an inch, though it is possible that they may have been formed upon the surface of mud, which would support the saline crystals; but it appears more likely, as the hoppers are often joined six together by a common apex, that the crystallization took place within the mass; the single hoppers, however, may have been near the surface, and the others below the surface. These hoppers are very abundant along Nine-mile creek, and no doubt in numerous other places: they are generally found in the friable part of the gypseous marl, and are readily destroyed by exposure. The same kind appear at the railroad, where it crosses the road to Bellisle. The harder kind are found near Syracuse in the Onondaga valley, and again on the hill to the east of Salina.

Evidence analogous to the preceding for the existence of common salt in this group, appears for that of sulphate of magnesia also. As a native salt, this sulphate generally presents itself in fibrous or acicular masses. It existed in the upper part of the group, above the gypsum, where numerous needle-form cavities appear, which are referable to that salt and none other. The best exposition of these cavities is at Reel's and Brewster's quarry, below Jamesville; the cavities appearing above the gypsum; their presence very observable from the drab color of the rock, and from the cavities being coated with coal. There is another layer to be seen a little higher up the creek, in which the cavities are in part filled with white lamellar limestone.

The general composition of this group does not differ from other saliferous deposits; red, greenish, drab and grey argillaceous and calcareous marls as they are called, forming the great mass of such deposits. With these earthy materials are the gypsum and salt masses, the latter sometimes found with the red portion, the gypsum usually with the lighter colored products. The information which is given us of these deposits is not, however, of a very precise character; very few of the kind rising above the surface, but a knowledge of them being generally obtained by wells, shafts and boring.

The recent discovery of rock salt at Rich valley, eighteen miles north of Abingdon in Virginia, to which the attention of the people of this State was directed by an able article in the Cultivator for September, 1841, is a fact of no small consequence to New-York; knowing of no fact which proves the gypseous or saline deposit of that valley to be different in age from that of Onondaga. The relative position of the rocks in that part of the valley is obscure, owing to great derangements, and rocks very different in age being brought together. I had no time to seek, in the prolongation of those masses elsewhere when examining them, the facts necessary to restore each part to its proper position, and thus determine the precise age of that deposit. When too late for insertion in this report, the Geologist of Virginia, no doubt, will have removed all obscurity. The facts observed, in few words, were these:

The valley is placed between two ridges, and is flat and covered with rich soil, in which are the salt wells, and from which gypsum and the calcareous greenish and variegated red marl were thrown out in their excavation. On the east side of the valley is Chesnut ridge, the layers of its rock dipping from the valley. It is composed of the limestone which extends from Pennsylvania to Tennessee, and is the equivalent of the calciferous sandrock of New-York. On the west side of the valley, rising also above its surface, are layers of limestone and shale, a part of the latter being slightly bituminous; these dip also from the valley, and at a higher angle: they contain the fossils of the carboniferous rocks. Between these deposits and the Holston river, are low hills of dark-colored encrinal limestone, in which no fossils were found as a guide to its position; but a few loose stones with fossils were picked up, which were referable to the Trenton limestone. West of the river, and dipping in the same direction with the limestone, and therefore apparently under it, were slaty layers with vegetable impressions. Back of these were olive and other colored sandstones, very hard, forming Brushy mountain, having Flat-top mountain in its rear, and rising to a considerable height; the layers of which were horizontal and undistinguished, the upper ones of white sandstone with Fucoides harlani; below, a red sandstone; under which were a series of layers, composed of limestone and fine-grained olive sandstone with shells, referable rather to the sandstone shale of Pulaski than to any other known rock.

These facts show that great derangement there exists, on no less than two or three parallels; that nothing was discovered to show that the Saliferous deposit was more modern than the Coal era; that from the existence on both sides of older New-York rocks, and from similarity of its own associates with those of New-York, there being no other deposit with like associates in the United States, the evidence is altogether favorable as to identity of age or era.[*]

From the fact made known by the deep boring at Salina in 1838, as detailed in the report of the following year, it was evident to Judge Allen, the Inspector, that so long as there appeared to be connection with the ancient excavation, there was brine; but towards the deepest part of the boring, (the whole being six hundred feet,) there was no reason to believe that any existed, other than that of the reservoir.

From the facts which repeated borings have made known, it is certain that the whole of the salt waters of Syracuse, Salina, Liverpool and Geddes, have a common reservoir; and the borings show that a deep excavation exists in Onondaga valley and its prolongation north, which has been filled up with sand and rolled stones chiefly, with the exception of the part occupied by the lake. So different is the nature of the mass in which the excavation was made, and the materials which fill it, that the two cannot be confounded, so perfect is the identity of the latter even in boring. The present depth attained in the excavation is 265 feet; the strength of the brine at that depth being about 20° greater by the salometer there in use, than that of the other wells or borings. The excavation therefore forms a drain and reservoir, in which the saline waters exist; and these must have originally been surface waters, which have acquired their saline materials in passing through the group, being connected directly with none other. The deeper the borings which have been made in the excavation, the stronger has been the brine; a fact of great importance to the people, since 21° are yet required to obtain saturated brine. Were this attained, and the reservoir should be as heretofore a never failing one, it would be of far more value to the State than the discovery of rock salt; as this would have to be extracted or dissolved in place for purification, the labor and expense of which would greatly exceed the making of salt from saturated brine, even with its soluble impurities, so easy are they to be gotten rid of when the natural process is imitated.

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[*] Since this article was written, a conversation has been held with Prof. W. B. ROGERS, the Geologist of Virginia; and from his statement, it appears that the opinion above maintained is incorrect; the evidence showing that the deposit in question belongs to a different age from either the New-York or the Cheshire deposits, being above the former and below the coal, and forming a part of the Old redsandstone or Catskill group; thus adding another deposit, with respect to age or era, to those already known.

The real depth of the ancient Onondaga valley cannot but be matter of conjecture: its present known depth shows that its outlet has been covered up by alluvion. It probably falls very short of the depth of Lake Ontario, which must have received its waters; and from the rather solid character of the Lockport limestone upon which the red shale is based, the southwest dip of that rock constantly increasing, would, as at the Falls of Niagara, with its limestone constantly increase the difficulty of excavation.

In the Report of 1839, the facts in relation to the reservoir and the source of its brine were made known, with the cause which separated the waters of the reservoir from those of the lake; a covering of lake marl forming the insulating medium. In the same report, the existence of salt in the group and the part which it occupied, were distinctly asserted, having given origin to the hopper cavities; and that it also existed in the cavities of the porous rocks, inclining at that time to attribute their origin to a cause which is not required for their explanation. The discovery of hopper cavities in the porous mass shows that salt existed therein; and there is no difficulty in believing that the pores were formed of the same mineral, especially as instances of porous rocks of like origin are already known. In that report, also, it was asserted, that from the permeable nature of the gypseous hills, no salt could be expected to be found above the level of the drains of the country; that it must be sought below their level, and in that part of the group where the salt had been known to exist; and from the dip of the rock to the south and west, it must be to the south and not north of Syracuse.

From the fact of hopper cavities existing in the porous rock, there is no objection to consider salt as having given origin to the pores, and there is no other mineral in the group to which they might be referred. From the size of the hopper cavities, and from the cubic arrangement of the greater number of them, it follows that the crystallization of the salt took place in the mass where they exist; which, with the previous fact, is favorable to the existence of rock salt in the group; the quantity of salt where these forms are found having been too small, and too much diffused, to overcome the resistance of the inert medium in which its particles were placed, its very soluble character favoring the diffusion.

The fact of the greatest development of gypsum being south of the northern outcrop, as conclusively shown at the quarries above Springport on Cayuga lake, and the constant association of gypsum with rock salt in all its known localities, are circumstances highly favorable to the existence of this mineral in New-York, since its location would be to the south of its salines, where no boring has yet been made ; a position which would harmonize with the consequence which results from the depth of the ancient Onondaga valley, requiring that the source of the salines should be beyond the direct influence of free percolating waters, whose outlets were in the valley.

And finally from the discovery of rock salt in Virginia, though it be true that the deposit is of a different age from that of New-York, the additional fact of the concomitance of salt and gypsum at that place favors the opinion advanced by Dr. Beck, that rock salt would be discovered in Onondaga, but not in that part of the group in which the deep boring was made.

It is to be borne in mind, that there is no intention to restrict the salt and gypsum to any particular part of the group, as matter of opinion, but as matter of fact purely, which limits these products through the three counties, and gives to them a defined position.

The dip of the group, as determined by a level made near Syracuse, is within twenty-six feet to the mile ; which appears to be smaller than the apparent one, and the one which the appearance of higher rocks south seem to require. Should it be the true one, and there is no reason to doubt its accuracy, it extends the excavation of the ancient Onondaga valley some miles south, from the softness of the mass.

The *Water-lime group* rises upon the Onondaga salt group, forming the base of the limestone range, and is an important group in the county for water cement and common lime. Numerous quarries for the former, and for both, exist along the whole line. The principal expositions are, near Manlius square, and along the creek below Jamesville ; in the hill at Split rock ; on Nine-mile creek, below Marcellus ; and at the outlet of Skaneateles lake. The two drab layers exist throughout the county, and are those which are burnt for water cement. This product, from the numerous useful purposes to which it can be applied, promises to become an all important article of commerce. Care, however, should always be taken to select stone of a good quality, and that the proper degree of heat be given to it ; and the finer it is ground, the better will be the cement. South of Manlius square, is the best locality in the district to see the greatest extent of surface of one of the layers of water-lime proper.

*Oriskany sandstone.* This is the next rock in the county to the Water-lime group. At the limestone quarry near Manlius, a few inches of it may be seen in the road above the Water-lime group, and beneath the Onondaga limestone ; also at Jamesville ; and in Onondaga valley, to the south of the village, showing, on the west side of the valley, in the side-hill, a ledge of about seven feet thick. Its greatest thickness in the district is on the old Seneca road between Elbridge and Skaneateles, appearing to be about thirty feet thick. Not far from thence, on a parallel road, is the quarry from whence this rock was quarried for the lock at Jordan ; which, though an inferior stone to some of the limestones of the county, yet resists wear and weather tolerably well, as is evidenced at the lock.

*Onondaga limestone.* This valuable building stone is coëxtensive with the Water-lime group, but two interruptions to its course as to outcrop existing in the county; one on Limestone creek, the other at Onondaga valley. It is more free from flint in this county, than further east. It is extensively quarried to the southwest of Syracuse, three quarries being opened along the same range for the enlarged Erie canal. The rock is tough and hard, requiring care in selecting such masses as are free from courses or parallel divisions caused by shale, into which water may penetrate and freeze, and thus divide it into smaller parallel parts. This is the only defect of this rock, which, however, is common to most stratified masses; but in this rock they are more numerous than in the base of the Trenton limestone, as it exists on the Mohawk, or in the birdseye.

This limestone makes first rate lime, but requires more wood to burn a given measure; making a heavier lime, which not being sold by weight, the lighter limestones are preferred, such as those of the Water-lime group.

The Onondaga limestone forms a terrace in many parts of its range through the county. The broadest is from Jamesville towards Onondaga valley, and along in the direction of the quarries on the opposite side of the valley extending towards Nine-mile creek. It extends up Onondaga valley, to where the road passes up the hill towards Lafayette. At Split-rock there is a sink-hole in the rock, which passes down for about one hundred feet, and then by an inclined opening into the valley below: the bottom and sides are said to be covered with ice. This opening I did not see.

North of Squire Brown's house, not far from Jamesville, there is a gulf in the water-lime of over one hundred feet in depth. At the bottom of the gulf is a pond, the bottom of which, it was said, was not reached by a line of one hundred and fifty feet in length. The Onondaga limestone forms the surface rock above the gulf.

The *Corniferous limestone* is exposed upon the Onondaga in many parts of the range, from the east to the west end; namely, near Manlius square, the road from Fayette to Pompey hill, both sides of Jamesville, Split-rock, Marcellus, and Skaneateles outlet. But little of it is quarried or used.

The *Seneca limestone* is abundant in the county, and many favorable points are presented for examination; such as along the side-hill at West hill, the quarry at Marcellus, the road by Jamesville, etc.

*Marcellus shales.* There is a greater thickness of these shales in this county than in any of the others; they are tolerably well exposed near Marcellus, and are seen in innumerable places upon the high ridge from east to west through the county. The lower division is met with at several points, showing its fossils, and excavations in various places have been made for coal. The lower division is best exposed along the road to the west of Manlius square, and in the quarry and along the small valley of the quarry towards Onondaga valley. Throughout they form the base of the next group; between which and the present, no well defined line of division has yet been observed, but the fossil character shows a difference between the groups.

*Hamilton group.* This group covers a great area, nearly one half of the county; extends south from the Marcellus shales, to the county line of Cortland, with the exception of some parts in the towns of Fabius, Tully and Spafford, which are covered with higher rocks, forming a part of those which project north from Cortland county, and which form the greater part of the surface of that county. The whole of the area of the Hamilton group presents a succession of deep north and south valleys, two of which are occupied by Otisco and Skaneateles lakes. The direction of these lakes, however, like those further west, inclines towards the southeast. The whole of the valleys which extend over the area are connected with southern ones, the waters dividing below the tops of the hills. Numerous small lateral valleys branch from the larger ones, affording facilities for the examination of the parts of which this thick group is composed. Besides these small valleys, there are a few of greater extent, the largest of which is to the south of South-Onondaga village, extending to the quarry near Marcellus village.

There is very little shale in this group of so dark a color, fine a grain, and so much disposed to be slaty as in the Marcellus shales; being more coarse, very fine sand of a brownish yellow color entering into its composition, which becomes evident from long exposure. In many localities, it appears as an exceedingly fine-grained sandstone of a yellowish grey color. Portions of the shales and sandstone varieties are calcareous. The great mass at Pratt's falls, Gamble's falls, the north shores of Skaneateles lake, and numerous other noted points, show the finer kind of shale; the coarser at Buhr's falls on a branch of Limestone creek, at Pompey hill in numerous places, at South-Onondaga, in the ravines of Otisco lake, etc.; and the more solid or hard kind forms the upper rock at Pratt's falls, the quarries on Pompey hill, etc. Fossils are exceedingly numerous throughout the whole mass; no locality without them.

*Tully Limestone.* This last of all the New-York limestones in the ascending order, appears in several places over the area occupied by the preceding group. Its localities are, near the village of Delphi; at the northeast of the town of Otisco; at Smith's, on the hill-side of the inlet in the valley of Otisco lake; on the opposite side of the same valley; on the road from Otisco village to Tully four corners; at the latter place also, whence its name; at Tinker's falls, on the edge of Cortland in Fabius; and near Borodino.

The *Genesee slate*, and the base of the *Ithaca group*, are the last and highest geological masses of the county, occupying the extreme southeast of Fabius, the larger portion of Spafford, and a portion of Tully.

The southern end of the county is somewhat peculiar, showing a system of broad, east and west valleys, interlocking with those whose course is north and south. The hills decline south, being quite low through the towns of Tully and Fabius, evidently the result of wear or washing away in the direction of the great north and south drains of that section.

## 9. CAYUGA COUNTY.

This county, from its extending further north than Onondaga county, contains two rocks more, the redstone of Oswego, and the extension of the Oneida conglomerate, which in this county is a sandstone, having greater resemblance to its extreme extension, the "grey band," below Rochester, than any part of its rock or mass to the east.

The *Red sandstone* covers the northern half of Sterling; appears at Sterling Centre, extending up the creek to the saw-mill; showing at the two places one of its products, namely, salt springs. From its red color, and containing brine springs, it was for a long time confounded with the red shale of the Onondaga salt group.

There are two localities where the sandstone of the *Oneida conglomerate* was seen; one at Hulme's quarry, to the southwest of the centre: the red sandstone appears in the road near his house. The other rock is about a quarter of a mile distant; color a light grey, some parts much intermixed with green shale, giving it a greenish color and mottled appearance: there are about five layers, but not thick. This quarry was opened for Wolcott furnace. The other quarry is on the road from Martville to Hannibalville, and was quarried for the mill at the former village.

*Clinton group.* Though its range is but through the town of Sterling, it is more and better exposed in this county than through Oswego and Onondaga. It appears in the creek at the village of Martville, extending down below the mill. It shows shales and their fossiliferous masses, which are calcareous, and make good fire-stones. It is with this part of the group that the lower ore bed is connected. Ore was reported to have been here discovered, but the spot was not made known. In common with the greater part of the Great level, this section is thickly covered with alluvion, sand and gravel being abundant. The red fossiliferous ore is found at Peter P. Van Patten's, which is but a short distance to the south of Hulme's quarry: the ground which contains the ore does not appear to rise more than about twenty feet above the rock in the quarry.

*Lockport group.* This is seen in several parts of the town of Victory, through which it ranges. The limestone is quarried at Doud's, on the road from the post-office to Martville: about four or five feet are taken out for lime. It has a little dark blue shale between the layers.

At Foster's mill near Plainville, the upper mass is concretionary, from six to seven feet thick, and its grain sparkling: its color deepens by exposure. Under this is a layer of about a foot in thickness, rather compact; below which are thinner layers.

At Hyde's, about three-quarters of a mile to the northeast, there are shales and thin tough limestone slate rather than layers. It is highly fossiliferous, and in its fossils corresponds with the lower division of the group as it appears at Wolcott village in the fourth district, being the only part of the third district where it was seen, though about sixty feet thick at that village.

The *Red shale* ranges through the town of Conquest. From the depth of alluvion and soil, it is exposed but in few places. Along the canal going east, it makes its first appearance about two and a half miles west of Port-Byron. It is associated along the canal with the yellow and green varieties. The boring undertaken by the State at Montezuma, was, in August last, three hundred feet deep, the rock being red shale, the details of which I have no knowledge. These borings are of great interest; for, according to Mr. Hall, the red shale is not seen beyond Wayne county, and but very little is there exposed ; and it is only by boring that a knowledge of its mass can be obtained. Its great thickness in Onondaga, its absence or obscurity in the fourth district, and the discovery of four feet of gypsum at Howland's island as reported in 1839, the gypsum being nearly forty feet below the level of Seneca river, are circumstances which tend to show a change, if that boring can be relied upon, in the extension of the red shale to the west.

The gypseous portion of the group widens greatly going west. At the east end of the county, it is very little over four miles ; but along Cayuga lake and its outlet, the part containing plaster is actually seen for ten miles ; and including the boring, about fourteen miles ; solely owing to the removal of its overlying masses, which, from Owasco outlet to the south side of Springport, show a curving of the limestone range in its rear, and the removal consequently of all its north and western portions.

Very little gypsum is quarried at the east end of the county : the only quarry noticed was on Owasco river, about two miles and three quarters south of Port Byron ; the quarries being on the lake, and near to Springport, as detailed in the annual reports, and under the head of the group.

The hopper cavities were noticed at the hill and road side to the south of Port Byron, but none were seen along Cayuga lake ; the gypsum there exposed, appearing, like the mass to the south of Port Byron, to be above the cavities.

From the exhibition of gypsum near Springport, there is ample for many years supply from the masses near to the lake, and which are but thinly covered. Further east, and in a northeast direction, there must be a never ending quantity, but which would require a different mode of extraction from that which is now followed.

Having no knowledge of the details of the new boring at Montezuma, nothing further suggests itself with regard to that saline. Nothing can be more commendable than enterprises of this kind, even if but negative results are obtained ; but if successful, the field of industry is enlarged, and the resources of the people measurably increased. The boring is one of promise ; the water flows over the tube at the rate of forty-nine gallons per minute, and is said to be of good strength.

The *Water-lime group* exhibits the same characters and associates as in Onondaga, and is readily traced from point to point along its range. It is quarried to the northeast of Auburn ; shows itself at the outlet just below the factory, and near the road from Auburn to Springport ; appears in the brook at Springport, and is quarried at Blanding's on the lake shore. At nearly all these places, the water-lime layer or layers are seen, and of as good quality, so far as judgment could be formed without actual trial, as any further east. In many parts of the range of the group, some of the layers of the blue limestone show numerous flinty accretions from replaced columnaria, as in Onondaga county, etc.

The *Oriskany sandstone* appears in the quarry of the New-York Company ; it is about two and a half feet thick, and its fossils in great numbers. They are numerous also at Yawger's quarry, near the road to Springport. Its thickness is about three feet. Throughout Cayuga it holds its place, but varies in thickness.

The *Onondaga limestone* is more persistent, but the quality varies greatly, though the parts exposed may not be fair samples of the parts which have never been uncovered. It is extensively worked at Auburn, the facings of many of the houses being entirely made of it. It is the stone, upon which the convicts at the prison are employed. It is readily traced along its range to Springport, the last point where it was seen being above Blanding's limestone quarry on the lake shore.

The *Corniferous limestone* is extensively quarried at Auburn, at the quarry at the outlet; the upper quarry of the New-York Company; the extensive quarry of Mr. Buhr; and those further to the east, upon the top of the water lime and the Onondaga limestone. Its character, from its nodules of flint, is well exhibited in all these quarries; the upper part showing from eight to ten parallel ranges in a thickness of about three feet. Below the flint, there is usually about twelve feet of good solid stone; the layers varying from one to three feet thick, and from nine to twelve feet much mixed with shale, and unsuitable for quarrying. Fossils are more abundant in this portion than in the layers above. The same order of arrangement, as to the nature of the rock, exists at Cherry-Valley, showing how general the action was along the whole course. The color is darker, however, at Auburn, the upper layers being almost black where fresh quarried; but the vertical joints are equally well defined, giving a work-like character to all its quarries. The corniferous forms the upper terrace at Auburn, the seneca being concealed by alluvion, and must be in the rear, the flinty layer forming the surface mass. There was no part of any extent uncovered, to ascertain if water-worn and scratched.

At Springport, to the south of the village, the quarry of Mr. Ham is opened in this rock. It is in thick and thin layers, the latter used for flagging. Between the layers, there is shale, the whole of a black color. At a higher level, a little to the south, is Howland's quarry, showing the upper part of the corniferous, with its nodules of flint, upon which is the Seneca limestone; the layers of both inclined at an unusual angle, being about 20°; their vertical joints proving that the change in the dip was anterior to the existence of the joints, these in all rocks yet noticed being vertical.

The *Marcellus shales* are exposed along the outlet from the main street in Auburn toward the lake, numerous septaria having been thrown out in deepening and enlarging some portions of it. They are seen in a few places, but obscurely, along the range towards the south of Springport; but in that section are more readily mistaken for those of the group above, from the increase of finer materials to the west.

The *Hamilton group* covers the greater part of Owasco, the northern part of the towns of Sempronius and Fleming, the northern part of Scipio, those parts of Springport which border on Fleming and Ledyard, the greater part of Ledyard, and all that part of the county which borders on Cayuga lake to the south of Ledyard, the breadth diminishing south; also the valley at the head of Owasco lake, extending south towards Milan. The finer kind of shale predominates in the county, showing some impure limestone, a mass of which appears in the bank on the lake to the north of Levana; the same being seen in the brook at Mr. Crise's, about two miles south of Springport. The coarser kind, and none of which was sufficiently so for a building material, shows itself on the lake shore to the south of Aurora. These two kinds as to hardness, form the great mass of the group. Fossils are in great profusion in this county, some detail of which was given under the head of the group. In the ravines near Kidder's ferry, the encrinal limestone, which forms a part of the group on Cayuga lake, there appears forming the first falls.

*Tully limestone.* This rock appears near Vannetten's mill in Sempronius; at the falls at Montville, and those of Moravia; on the opposite side of the valley, on the road to Stuart's corners; on the road from Aurora to Ludlowville, in two places; and in the ravines whose waters flow into the lake from the north line of Genoa to Tompkins county. It is usually about sixteen feet thick, some of its separate layers being several feet in thickness. They differ greatly in purity: some make a strong, but not a white lime. From its hardness, it generally forms the falls of the brooks and other water courses, where more usually it is seen.

The *Genesee slate.* This is well seen in the ravines near Kidder's ferry, resting upon the Tully limestone, with a thickness of over eighty feet; showing a range of septaria near the Tully limestone, and another near the top of the mass. The thickness in this ravine appeared to be greater than farther south. The slate shows itself in other localities, but not to the same advantage.

The *Portage* and the *Ithaca groups.* These terminate the whole of the rock series of the county, being the upper ones resting upon the last named one. It consists chiefly of shale and thin layers of sandstone, forming the base of the group. It covers all those portions to the south of the county, excluded from the limits of the Hamilton group.

Since the close of the survey, an interesting note was received from David Thomas of Scipio, accompanied by some small cockscomb crystals of gypsum from the upper part of the Quaternary or Chittenango deposit near Springport, which is made up in great part of the gypseous red shale. The crystals had not been observed. There was also a part of a jaw of a small ruminant animal, supposed to have been derived from the same deposit, and appearing from its color, etc. to be in a fossil state. The writer of the note also directs attention to the different colored bricks, which the clay at Carr's brick-yard above Springport produces; part of the mass burning red, and a part of a sulphur color, showing a twofold origin or source from whence the clay was derived. The crystals of gypsum, and the jaw, are in the State Collection.

## 10. Cortland County.

The same characteristic features of the south part of Onondaga county, namely, broad and flat valleys, and low hills, extend into Cortland county, through the towns of Preble, Homer, Truxton, and to the south of that town towards Solon. The hills rise to the south; the whole drainage of the county, with the exception of a small part in Virgil, being effected by the Tioghnioga or Onondaga river commonly so called. This river presents no such barrier; their are no falls, but rapids; the valley south, with some few exceptions, is narrower and less level than at the north, appearing as though the drainage or excavation of at least a large part was the effect of a flow north, and not in the present direction.

The county presents but a few of the rocks of the district, the lowest of which are those of the upper part of the Hamilton group, which project from Onondaga county. These are found only in the north part of the town of Truxton, extending east from Tinker's falls. The Tully limestone being a continuous mass through that section of the district, it will be found in all places where the space between the Genesee slate and the Hamilton group is uncovered, but was not seen in the county.

The *Genesee slate* is exposed to a considerable extent in the side-hills in the towns of Preble and Truxton, and in parts of Homer; these hills extend through those towns, being the north prolongation of the southern overlying masses, some of which terminate in Cortland, and others in the east and west valleys of Onondaga county. The termination of some of the hills is quite abrupt, and when viewed from the broad level valleys north from which they rise, are highly picturesque. The Indian tradition of coal existing in this rock near Preble corners, before noticed, has no foundation in fact.

The *Portage* and *Ithaca groups* form the greater part of the surface rocks of the county. They are but thin at the north, increasing in thickness going south. They cover the whole of the towns of Cortland and Solon, the greater part of Homer and Scott, and the terrace between Truxton and Solon. They extend south along on both sides of the Onondaga river, diminishing in breadth south, and also along the Otselic river in Willet and Cincinnatus.

Numerous quarries are opened in these groups, for building stone and flagging. The color is more generally olive, than at Ithaca, where but a small part of the mass comparatively is of that color.

On the east branch of the Onondaga, about a mile or more above Port Watson, and to the east of Homer, are the quarries of Miller and of Derby. To the south of the same villages, are those of Stephens, of Rose, and of Betts. This latter shows, in the ascending order, grey sandstone with no regular lines of division or layers; above this also sandstone, thin, and somewhat regular in its divisions, capped with argillaceous layers, rather broken; the whole above twenty feet in thickness, and opened along a line of four or five rods. The quarries are above a mile from Port Watson.

Bellows quarry, from which nearly all the flagstones used in Homer are obtained, is on the hill-sides to the east, and between Cortland and Homer. The lower part of the quarry consists of flags from one to six inches in thickness; not so smooth or straight as those of Sherburne, but waved like the slight movements which water produces upon a sandy bottom. The flags, etc. contain fucoids large and small, some of which anostomose, and all are smooth. Above these layers, there is a line of concretions about a foot or more in diameter, with shale. On the top of these are slaty, broken up and partly decomposed layers of shale and sandstone, forming the refuse of the quarry. Some of the lower layers of sandstone contain vegetable impressions, and show small accumulations of coal, owing to the alteration which the material of the plants have undergone.

North of Homer, also, are the quarries of Bishop, Barrow, &c. In a ravine on the west side of the valley, about three miles to the north of the village, in which is the saw-mill of Mr. Hotchkiss, there is upwards of fifty feet of shale and sandstone exposed; the shale greatly predominating, and the whole of a dark grey color.

The last quarry noticed in the valley was Harris', about a mile south of Preble. It furnishes good building stone, and contains the same vegetable impressions found near Homer.

*Chemung group.* This group covers the southwest part of Virgil, being the highest land of the county. Not much rock is exposed, the quarries opened being principally for field enclosures. The same group appears to exist also where the towns of Marathon and Willet, Freetown and Cincinnatus, join each other. It is the terminal mass of the county, and extends south beyond the Susquehannah river.

The valley in which the villages of Cortland, Homer and Preble are seated, is broad and level, filled to an unknown depth with alluvion, showing in many places that no small part of its mass are the rolled stones of the rocks to the north of the Limestone range. The valley resembles, in most of its features, the parallel one in Madison, through which the Chenango canal passes, and shows a like origin; the difference being that the one was excavated in the Hamilton, the other in the Portage and Ithaca groups.

Ponds or lakes are also alike common to both valleys, being the deeper points which were left when the waters were drained from their surface. These ponds have also the same lake marl deposits, and derived equally from the same materials, the calcareous alluvion of the northern region, which extends through all the southern valleys. A chain of these lakes extends from those near Tully, through Preble, to the north part of the town of Homer. They contain marl, but no use has as yet been made of it.

Another and small cluster of marl lakes or ponds exists to the southwest of Cortland village. These ponds are three in number: Crandall's covers an area of fifteen acres; Swain's, six acres; and Chatterdon's, four acres: they are near to each other, and connected together. The marl is partly of an ash color when recently taken out, owing to vegetable matter, but whitens by exposure to the air. The marl, with the exception of the small quantity of vegetable matter, being a pure carbonate of lime, when properly burnt, it makes the best of lime. A considerable number of bushels of lime are here annually burnt: the marl is dug, partially dried, moulded into bricks, and then thoroughly dried and burnt.

From the abundance of aquatic plants in the ponds, and from their being more or less covered with marl, an idea exists that they originate it; whereas they are but points of attraction, to which the marl adheres in separating from its solvent. The ponds are seated in alluvion, from which the calcareous material has been derived which covers their bottom. The greatest known thickness of any of these deposits of marl is about twenty feet.

## 11. CHENANGO COUNTY.

This county, like most of those of the southern tier, consists of high ranges of hills, with broad surfaces, and with deep valleys more or less level. The Unadilla and the Susquehannah form the east boundary of the county, ranging with the Chenango, which passes somewhat diagonally through the heart of the county; these rivers being seated in equally deep valleys, and the land rising into hills of several hundred feet of elevation. There is no other stream of importance, connected with the county, except the Genegansette river, whose course is north and south, emptying into the Chenango below the village of Greene.

The lowest rocks of the county are those belonging to the Hamilton group. It contains also the Tully limestone, the Genesee slate, the Portage, the Ithaca, the Chemung and the Catskill groups.

The whole of the *Hamilton group* is confined to the towns of Sherburne and Smyrna, and to a strip extending along the Unadilla river through the towns of Columbus and North New-Berlin, below the village of which it passes under the higher rocks. It is well exposed along Handsome brook, to the northeast of Sherburne village, exhibiting a mass from sixty to one hundred feet thick, chiefly of the dark-colored shale of the group, and abounding in its characteristic fossils. The falls in the creek are over the shale, which extends towards the mouth of the creek, and is soon lost under a covering of alluvion and soil, being the most southern part of the Chenango valley where seen.

The same mass makes its appearance to the east of the village of Smyrna; beyond which, at a lower level, are those of the upper rocks of Hamilton seminary, and of Ladd's quarry on the canal above Sherburne.

The ridge from Madison county, composed of the Hamilton group, appears to incline rapidly near Sherburne, so as to admit the Sherburne flags to appear at the level which they present, at less than two miles below the village.

At North New-Berlin, the group is exposed in the sides of the creek; and at the quarry, and mill-dam back of the village, on the road to Chenango valley. The fossils are numerous, and the same in all respects with those in the creek near Sherburne.

The *Tully limestone* was seen but in one locality at the northwestern part of Smyrna, on the road to De Ruyter village, where the road crosses the west branch of the Chenango.

*Genesee slate.* But little was seen in the county: it does not form the same well defined rock to the east, which it does to the west. It appears along the same road as the Tully limestone, and at North New-Berlin, &c.

*Portage* and *Ithaca groups.* These groups appear to be the surface rocks of the town of Lincklaen; of the west parts of Pitcher and German; of Otselic; the northern part of Pharsalia; all those parts of Smyrna, Sherburne and Columbus, not occupied by the lower rocks; all but the southwest part of Plymouth; the northern and west portion of North-Norwich, the group extending upon both sides of the Chenango below the village of Oxford;

and the east side of the town of New-Berlin, with the exception of those parts towards the the river, where the rocks of the Hamilton group hold position.

Numerous quarries are opened in all the different towns in this group, for building-stones, and for flagging: the better kind of the latter occurs in the lower part of the group. The first year of the survey, several points south of Sherburne were examined, among which was Mr. Skinner's quarry, where the flags were large and smooth, but the quantity of shale and slate upon them was considerable. At Church's quarry, about two miles from the village, they were more accessible, but not so good. The opening here is about twenty feet in depth upon a side-hill, rising about forty feet above the valley, and showing dark blue or blackish slaty shale with the sandstone. The same appear in the quarry at the back of North New-Berlin village, showing the Graphic fucoids of Cayuga lake, Ithaca, &c.

West of North-Norwich, in the higher parts of the group, is the quarry of Mr. Harris, opened for the Chenango canal. The stone is of fair quality for the group generally. Fossils are somewhat numerous, and it is the second best locality of the Curtain fucoid.

At Norwich, the county town, many quarries have been opened in the hill to the west of the village and elsewhere: the stone is inferior in quality to that of the upper group.

*Chemung group.* With the exception of the town of Greene, this group is rather obscure in the county. But little was positively recognized in the Chenango valley to the north of that town; although from its great thickness south and west, it should there appear; but it is also possible that it terminates short of the north line of the Catskill group, which may extend beyond it as at Oneonta, where no part of it was recognized, and where the Catskill group appears to repose immediately upon the Portage and Ithaca groups, or a mass which corresponds with the side-hill quarries at Norwich and Port Crane, and which by the fossil character are referable only to those groups.

The consequence of the Catskill group overlapping the Chemung group to the northeast of its range in the district, was not sufficiently attended to; but this can be no subject of surprise to those acquainted with like, or any other kind of investigations. After a full digest of the facts collected has been made, very little observation in the field will remove all difficulties. There were none supposed to exist, until too late in the survey to commence a re-examination.

The valley is quite broad at Greene, and level, and the hills appear to diminish in height going from Norwich to that village. The outlines of the hills are low curves, forming surfaces of great beauty, and admitting of ordinary or plough cultivation.

The only opening noticed in the hills at Greene, near the village, is Cameron's quarry, which was wrought for the canal. In mineral character, the contents of the quarry greatly resemble the group in most of its other localities. There are fossils which show identity. It also contains the large species of encrinite, so common, and which appears to be confined to this group: it is almost invariably replaced, in great part or wholly, with lamellar carbonate of iron. The upper part of the quarry is a compact rock with concretions, and the lower part consists of thin and irregular masses with slaty shale: the floor of the quarry showed tentaculites.

*Catskill group.* This group has an extensive range in the county, covering a large area of the high ground between the Unadilla and the Chenango, and between the Chenango and the Genegansette rivers, and extending in places to the west of the latter. It affords better building materials than the lower rocks of the southern counties, especially the grindstone variety, which occurs to the west of the Chenango river. This latter rock is abundant in the towns of Preston, Macdonough and Pharsalia. .It is easily wrought, is of a good lively color, and is the handsomest building material of the whole of the southern counties.

### 12. Broome County.

The characteristic features of the county are, first, the broad valleys, and deep ones too in some places, through which the Susquehannah, the Chenango, Tioghnioga, and other rivers flow ; and secondly, the high elevations to the south of the Susquehannah, and to the east of the Chenango, which cover the greater part of the towns of Colesville, Windsor and Sanford, in which the Cookquago, the Oquaga and the Randolph mountains so called are situated. The west side of the Chenango river, extending up to Cortland county, is much less elevated, owing to the absence there of the upper group which covers the higher parts of the county. The whole of the valleys are valleys of excavation, their breadth and depth showing the greatness of the action of water.

No other rocks have been recognized in the county, but those which belong to the Chemung and Catskill groups, with one local exception. The former occupy the whole of the county to the west of Chenango river and Chenango county, and north of the Susquehannah. It borders also the latter river on the south side, keeping at a distance of a mile or more from the river, as the high hills of which it forms the base advance or recede from it ; from thence it extends into Pennsylvania. In like manner, on the return of the river into the county at the Great bend, it skirts both sides in its passage, so to speak, into Chenango county. It also covers a part of the county to the east of Chenango river, disappearing under the Catskill group of the higher elevation.

Numerous quarries have been opened in the group, especially near Chenango river, for the purpose of procuring stone for the canal ; among which is Smith's quarry, on the hill not far from Port Crane, which illustrates the variableness of the mineral nature of the group ; showing a mass of hard sandstone, which extends for forty or more feet with considerable regularity, and then terminates in the shale ; the same kind of slaty shale which occurs above and below it, taking its place.

Near Binghamton, the quarries are more numerous ; and a few are more extensively worked, such as Brown's, about two miles above the village, on the west side of the Chenango, and near the top of the hill.

There are several openings in the hill-side at Port Crane, not far from the level of the canal ; where some of the same fossils which exist at the quarries near Norwich, and near the canal also, are found. These fossils belong to the Hamilton group, and unless they have a high range, which I am disposed to believe, would bring the Hamilton and the Chemung groups together in two or more localities. They are anomalies, which further observations are required to explain or remove. For were the fact as above supposed, then this consequence would follow, that the whole of the rocks of these counties present a series of curves or undulations, in some of which one or more of the different masses from the Hamilton to the Catskill group existed, and in others were wanting; these instances, like the quarries at Port Crane, &c. belonging to an undulation where the Portage or Ithaca groups were extremely thin, bringing the Chemung and the Hamilton groups within a few rods vertically of each other, far above the mass which contains the fossils of the Hamilton group, the well known Graphic fucoid appears.

A fact of some interest, and which shows the importance of a knowledge of the structure of the earth before commencing expensive undertakings, is the salt-boring which was made in this county. In that part of the county generally known by the name of the Triangle, in the town of Barker, about five miles north of Chenango forks, a boring for salt water was made, which is every way worthy of record, as showing the importance of geological knowledge in like enterprises. In the valley of Halfway brook, water showing a perceptible saline taste had been discovered in many points along the line of the brook for seven or eight miles. The place chosen for boring, was an old deer-lick, which had been an Indian camping ground of some note, and where salt in small quantities had been made by them.

The boring was first commenced in 1827, and continued at intervals until 1838, when it was suspended for want of funds, the amount expended being about five thousand dollars; and the depth attained was about four hundred feet, all which, with the exception of the first twenty-nine feet, was in the rock, consisting of hard and soft dark olive and bluish shale, with alternations of sandstone. A journal was kept of the different kinds of hard and soft rock which were penetrated, and of their thickness, and the strength and quantity of water, which increased in both respects with the depth of the boring, but not to that degree which would make it an object of importance. A small quantity of salt was made, which was very white, and appeared to be of good quality. A portion was handed to Dr. Beck for examination. Had the water been stronger, and abundant, it would be a matter of some importance for that country, where wood is cheap, and a ready market existed south for salt.

The boring was commenced, upon the supposition that the salt water of the springs or marsh was furnished by the same source which supplies the Onondaga salines; and to obtain a like supply, all that was required, was to obtain the same geographical level; not aware of the dip of the rocks, their number and thickness, and that the boring must extend to the gypseous mass in order to obtain success, being wholly independent of geographical level.

It is very certain, that had correct information of the rocks of the county been possessed, the boring would not have been undertaken, unless superabundant means existed, and as an object of experiment merely. The boring in all probability commences near the bottom of the Chemung group, and does not go through the Ithaca group; requiring from a thousand to twelve and more hundred feet, to attain the source of the salines of Onondaga, should the thickness of the intervening masses continue in that direction, of which there is no reason to doubt, from observations along Cayuga lake, and the reäppearance of the same rocks in Pennsylvania, if not wholly, yet in greater part.

No error could be more natural than the one which was made. Salt water existed in the valley, being perceptible at many points. The position of the valley was directly south of the Onondaga salines, the slope of the country being also the same, and the source of the salt water not correctly understood, the number and thickness also of the whole of the interposed rocks unknown.

Nothing can be more laudable than that spirit of enterprise which leads to like undertakings; but to ensure success, it is requisite that all preliminary knowledge should first be obtained. The failure in the valley of Halfway brook conclusively proves, that had the survey preceded the boring, the latter would not have been made, excepting as a matter of experiment, and with superfluous funds.

The *Catskill group* covers the highest grounds on the south side of the Susquehannah, and the high grounds also to the east of the valley of the Chenango, extending over to Delaware county. But little red rock is to be seen, and that chiefly in the northeast part of the county. The group consists principally of greenish and greyish sandstone, and shale; the sandstone more abundant than in the group below.

In the county are many excavations in the group, made for coal; two or three of which are on the farm of Mr. Brunson, near the top of the hill, at the foot of which the Old Randolph road passes from Windsor to Binghamton. The sandstone shows the peculiar diagonal and curved structure common to this rock. The coal which was discovered, were small accumulations, owing to the presence of a few of the flag-like leaves so often met with, from the Ithaca group upwards: their material being in the state of coal.

Another locality of supposed coal is on the road from Harpersville to Binghamton, near Colesville, in a small brook on the farm of Mr. Waters. Numerous similar impressions of plants there occur, converted into coal; the rock being the same, and the coal in no great amount.

## 13. Tioga County.

This county embraces the towns of Berkshire, Newark, Owego, Candor, Tioga, Nichols, Barton and Spencer. Its surface is broken into high ranges of broad hills, and valleys; some of which, like the Susquehannah, and the east and west Owego creeks, are broad and deep.

The excavation and removal of rock has been immense in this county, especially near the junction of Cayuta creek with the Chemung and Susquehannah rivers: a broad alluvial plain there exists, extending up the creek beyond Factoryville. The plain shows from three to four distinct terraces of alluvion, the highest rising some sixty or eighty feet above the river. North of Factoryville the hills reäppear, and continue to a range of east and west valleys, in which are the villages of Vanettensville and Spencer; there they sink, but rise again on the opposite side, and continue thence unbroken to Cayuga lake.

On the east side of the county, the north and south valleys are important ones, from their breadth and fertility, being the finest parts of the county.

Though the hills rise to a considerable height above the Cayuta, for example, being estimated by some to be over five and six hundred feet where highest, no other group than the Chemung was noticed in the county, north of the Susquehannah river; and but two groups only were seen in the entire county, the Chemung group occupying the area just mentioned, and occurring also on the south side of the river, spreading south as the high hills recede from it; the highest points being covered with the Catskill group, the second one of the county, which extends south into Pennsylvania.

The rocks on both sides of Cayuta creek abound in the fossils of the group, and a small quantity of limestone is associated with them; the material being often sandstone in which they are imbedded, and is one of the most durable rocks of the county.

Nothing of a mineral or a rock character was observed, which requires much other notice; it being difficult to give precision or interest, where the masses which compose this and some of the other counties are of so mixed and indefinite a character. Among the notes taken by Mr. Car during the two years that he was the assistant of this district, he states that near the mouth of Merick's ravine in the town of Richford, there is a mass of ferruginous shale, containing accretions of iron ore. The same also were noticed by him in Pleasant valley, near Spencer, above a series of shales and sandstone. They are, however, so poor in oxide of iron, as to be worth nothing excepting for the fact of their existence.

The Catskill group is confined altogether to the south line of the county, covering the high point between the Susquehannah river and the State line, being the extension of the broad and long mass in Pennsylvania. It presents nothing of note in the county; but near the State line, on Appalachian creek in Pennsylvania, a report of the discovery of coal in the group was circulated during the survey. Two diggings were made, not far from each other; the first, at a lower level, was in light grey sandstone, which contained a few broken vegetable impressions, resembling spear grass, and some of the larger kind also: the accumulation of a few of which being in the state of coal, gave rise to the report. The second digging was in a slate rock, which was less promising, containing fewer plants.

On the east side of the creek, on the land of Mr. Clifford, about three miles distant from the coal digging, there is an important ledge of limestone, being the only one in all the southern section of the country. It is a part of the Cornstone mass of the Catskill, which in that part of Pennsylvania contains much more carbonate of lime than the same rock in New-York, where it evidently has thinned out. It appears near the top of the hill, and is from twelve to fifteen feet thick. It makes a strong lime, but is too much colored for whitewashing, or to be used for the last coat of plastering; owing to iron and manganese, which appear to accompany the particles of limestone in all the upper rocks, the carbonate of iron being in considerable quantity at the upper part of the Catskill group, and under the coal deposit in the neighborhood of Ralston in Lycoming county, Pennsylvania; and it is there worked, affording the purest of iron.

## 14. Tompkins County.

The east half of this county, embracing the towns of Lansing, Groton, Dryden, Caroline, Danby and the east half of Ithaca, belong to the third district, the county being divided between this and the fourth district.

The lowest rocks of this portion of the county are those of the Hamilton group; but they are only to be met with along Cayuga lake, commencing at the north end of the county, and continuing up the lake to near Bloom's lime-kiln, below which they disappear under the Tully limestone and the lake. They are well exposed along the creek at Ludlowville, disappearing also under the same rock at the falls in the creek, and the ravines near the village.

The *Tully limestone* is the next rock in succession. It is also seen in the same range of country, being well exposed along the lake, and readily traced from the county line to the kiln, where it was quarried and burnt for lime. Along the shore in many places are numerous large blocks of the rock, which have fallen from the cliff, owing to the removal of the soft shale beneath it upon which it rested. Blocks of this rock have been transported many miles south of the head of the lake, along the high grounds of the Cayuta and Six-mile creeks, and are quarried for lime; also on the road to Dryden, three or more hundred feet above the lake.

The *Genesee slate*, the common associate of the limestone, also appears on the same side of the county, ranging with the two lower masses, and showing a greater extent of surface, as may be seen along Salmon creek; and extending up the creek from the falls over the Tully rock, as well as in some of its other branches, the south one for example, where it forms two falls.

*Portage* and *Ithaca groups*. These groups cover the remaining part of the town of Lansing, the whole of Groton, the northwest half of Dryden, and the southwest part of Ithaca. The lowest layer along the lake is a hard solid sandstone of variable thickness, some parts about four feet, being the maximum. They show at Falls creek, Cascadilla creek, the Inclined plane, and at McCormick's quarry, some good building stone; but the great mass consists of rather hard and coarse shale, some quite slaty. Though the shale is somewhat enduring in the mass, when the edges merely are exposed, as is obvious in the cliffs along the lake, and at the falls of the creeks near Ithaca, the Inclined plane, etc., yet it is but a perishable material when otherwise exposed.

*Chemung group*. In the present state in which this group is placed, but little need be said, especially as it must occupy but a very small part of the east half of the county. Considering it to commence towards the upper part of the Inclined plane, no change whatever was noticed in the dip of the rock, so that it must cover the whole of the south portion of the county. In an economical point of view, the question of the Ithaca and Chemung groups involves no consequences of any importance whatsoever. Their interest is as regards classification, which forms, as it were, the fulcrum to the lever of the human mind; and the more firmly the former is planted, the more steady are the operations of the latter, and the higher will be its achievements.

## CHAPTER XI.

### *Explanation of that part of the Geological Map of the State, which relates to the Third District.*

This report was put to press and finished before a proof of the map was obtained: it will therefore correspond with what was expected, and not with that which may appear. The discrepancies cannot, however, be great, as the construction of the map is very simple; and should any exist, the reader can correct them for himself, though they will be avoided by the subsequent reporters.

The whole of the northeast boundary of the district, with the exception of the rocks of Jefferson county, is of *Primary rock:* it is colored of a light pink. The outliers of the same rock form patches, as it were, one at the uplift of the Noses, another at Little-Falls, the third at Middleville, and the fourth to the north of St. Johnsville; and are of the same color, but of a darker hue, in order to contrast the more strongly with the surrounding masses, being but mere spots.

*The Potsdam sandstone* exists but in patches in the district, and is confined to the northeast part of Lewis county: it is colored by burnt sienna.

The *Calciferous group* is of an orange color. It forms a large portion of the surface of Montgomery county, extending from about a mile or so in some parts on the south side of the Mohawk, to the Primary region, or the part of a pink color. It forms two large areas on the east and west side, and a middle one at the uplift of the Noses. It appears in Herkimer county on East-Canada creek, extending north from the Mohawk river; at Little-Falls also, along Spruce creek; and on West-Canada creek, extending for about three miles below Middleville, with some interruption, to a little within the line of Oneida county.

The *Black-river limestone* and the *Trenton limestone* are represented by an indigo color, it being inconvenient to separate them in a map whose scale is so small. They form a band, extending west from Black river into Oneida county from Jefferson county, and thence on to Spruce creek; branching at the waters of Steuben creek, and extending to the Mohawk by Beaver meadow creek, and also along the valley where the villages of Stitsville and Holland-patent are seated. It appears in patches on the north and south sides of Little-Falls; at Middleville, and Newport on West-Canada creek; below the high falls on East-Canada creek; south of Brocket's bridge, forming a part of that unrivalled uplift; at the lower uplift on the same creek; at the ferry on the south side of the river; on the south side of St. Johnsville ferry;

and in one or two patches to the north of St. Johnsville. Near Ephratah, it shows a patch at some distance on the south side of the village, and one of more extent to the northeast. Along the Mohawk, on the south side of the river, it caps the lower uplifted rocks, and extends to the east end of the Noses, visible in all places except where covered with soil or fallen materials. On the north side of the river, it appears in several places, coming out from under the Utica slate, between Mother creek and the calciferous of the Noses. It shows a patch at the quarries of Humphries, Sage and Reed, and at Stanton's on the south side of the Mohawk. On the north side, it appears in small surface expositions near Fonda, Tripes hill, Amsterdam, Marcellus' quarry, and the two insulated hills between the quarry and river. Finally, in the northern part of Montgomery, two patches occur in the town of Broadalbin, and one in Mayfield.

The *Utica slate*, which succeeds to the preceding limestone masses, is colored of a dark shade of purple. It sheathes the lower rocks on all their southwestern border, but from uplifts and denudations, it also appears to the north of lower masses. From the west end of East-Canada creek, it may be traced continuously to Jefferson county. East of that creek, from greater derangement and denudation, it is only a continuous mass on the south side of the river.

The *Hudson-river group*. This group is colored of a lighter purple. It forms a range on the south side of the Mohawk river, and to the south side of the Utica slate, and continues thence to the west of Utica, where it appears also on the north side, increasing in breadth from Rome, where it begins to curve north; passes through Lewis county into Jefferson county, or the second district; and reäppears again in the third district in Oswego county, making another curve. Its greatest breadth is in the northern part of Oneida and Lewis counties; but its greatest thickness is at the east end, on the Mohawk. It appears in three large patches, one conjointly in Herkimer and Oneida, and two others in the latter county.

*Grey sandstone*, colored of a shade of grey. This rock is only found in the counties of Oneida, Lewis and Oswego. It begins to show itself to the south of Rome, and covers a large area in the two latter counties.

*Medina sandstone*, colored indian red. It must commence near Rome also, but is first distinctly seen in a branch of Fish creek. It forms the rock surface of a large area in Oswego county; and but little is exposed in any one place, from the immense accumulation of drift or alluvion which covers the greater part of all that county.

*Clinton group*, etc. The part which is colored of a yellow or pea green, is the *Clinton group*, including the *Oneida conglomerate*. These commence near the east extremity of the district, near the foot of the Helderberg cliff or range, and extend through the district. The Clinton group occurs on both sides of the lake, near the outlet of Oneida lake. The scale of the breadth of the lake being rather too great, gives a greater width to the group upon the map than it is quite entitled to.

The *Niagara group* is colored with prussian blue, and consists of the limestone of Niagara falls, Lockport, &c. and the shale beneath that rock. It gradually diminishes from the west, and disappears towards the east end of Herkimer county.

*Onondaga-salt group*, colored of a yellow ochre. This group forms a part of the Helderberg division, being part of the mountain range from Otsego county, to near the Hudson river; but as it covers a large surface, the geographical rule, which should always have preference in like cases, is adopted. This all important group, as has been before stated, makes a part of the cliff to the east, merely showing its northern outcrop; but in going west, it constantly presents more and more of its surface, from the superimposed rocks having been removed, which enables it to exhibit a long line of breadth at the west boundary of the district. The part which is composed principally of red shale, lies to the north generally of the Erie canal, from towards the east end of Madison county, to the east end of Wayne county, being the west limit of the district.

*Helderberg division*, with the exception of the Onondaga salt group, in which case the term *range* is always used: it is colored of a light prussian blue. It forms an uninterrupted range or mountain cliff, from Schoharie county to near Sauquoit creek. From thence west, it is cut down by the many water courses whose discharge is to the north, many of which are wide and deep; and no correct delineation of the ridge could be made without a correct map, and which must be the result of a topographical survey.

The *Erie division*, which consists of the *Marcellus shales*, the *Hamilton group*, the *Tully limestone*, the *Genesee slate*, and the *Portage* and *Ithaca* and *Chemung groups*, constitute two great divisions as to color: the two lower members are represented by very light purple, and the three upper by a light burnt umber. The Genesee slate being unimportant as to surface distribution, is not noticed.

The *Catskill group* is of red ochre, and is confined to the counties of Otsego, Chenango, Broome and Tioga.

From the very small size of the map, it was judged better to confine it entirely to the representation of the rock masses of the State, leaving out the whole of the quaternary products; the insertion of which would have made it so complicated, as to be useless to all but those already well acquainted with the subject. Unless a map is upon a large scale, it is not practical to combine the two, without greatly imparing the value of the part which pertains to the rock masses. Where the greatest gain is desired, the rock masses and the quaternary products should be laid down upon separate maps. It is the intention of those engaged in the Survey, to place a large map of the State in the Geological room in Albany, showing both the rocks and the quaternary products.

The Third District is an important one, for it contains the whole series of rocks, from the Primary to the Catskill group, with some exceptions. The first are those which relate to the Taconic system, of which the district gives no light; the second and last is the Schoharie grit, which probably is wanting, not having been seen in place. With the exceptions of partial uplifts of the Mohawk and its north vicinity, the whole of the rocks of the district are relatively undisturbed, exhibiting a general dip to the southwest, the entire mass of the rocks of the New-York system inclining from the primary nucleus. There are undulations, no doubt, in the great mass to the south of the Mohawk, forming a part of a system of disturbance which extends south and east through the Union, of which little or nothing was said, the proof not appearing in the district in a way which could be made satisfactory to others. The dip or inclination of the rock to the southwest shows as a consequence a rise to the northeast; the primary attaining to three times the height, where most raised, to its superimposed rock. From the great denudations which have taken place along Black river, exposing the edges of the rocks from the surface of the primary upwards to the grey sandstone; from the still greater denudation as to breadth, north of the Helderberg range which descends to the Utica slate, which forms the undisturbed rock of the Mohawk valley, every possible facility is afforded by these enormous excavations, and by those of the north and south valleys, for the examination of the strata of the district. The uplifting of the Primary mass, and the destruction of the whole of the superincumbent masses for some distance from its centre, enables the examiner rapidly and with certainty to pass from one rock or mass to another, and to give sections of actual contact for the greater number of the different rocks of the whole series. From the partial uplifts having deranged portions of the lower series from the west of Utica east, it is necessary, in order to obtain an uninterrupted succession, to commence to the west of that city. Thus, starting from any point in Lewis county on the Black river, and going southwest to the Coal range of Tonawanda and Blossburgh, the whole of the New-York system, with some exceptions of the Helderberg division, will, in traversing the intermediate space, appear in succession; the last of which, the Catskill group, will be seen passing beneath that southern range, being the rock upon which the Coal deposit rests from Blossburgh east.

The whole of the rocks of the district are well illustrated by the two lowest sections upon the map. The first or lowest shows the succession from Ogdensburgh to Blossburgh, and is the most complete as to number of rocks and groups which any section in a straight line through the State could give: it shows the sequence from the primary to the coal. The second section passes by the gap of Little-Falls, and exhibits an insular appearance of the overlying rocks of the primary at that place, the latter forming the base of the gap. The section commences with the Primary at the north, and terminates with the Catskill at the south.

# CHAPTER XII.

## *Of the Rocks collected for the State and for the Colleges.*

The collection of rocks which was made for the State Cabinet, is nearly arranged, and upon a plan which affords an opportunity of becoming readily acquainted with the whole of the rocks of the State, according to their mineral and especially their fossil character, and in the exact order of superposition. The plan adopted was to appropriate the whole of the upper part of the building to the Geological department, making a twofold division in the department, reserving the whole of the lower floor for a systematic arrangement according to kind and order of superposition; keeping the gallery which surrounds the room, exclusively for a geographical collection, or according to the counties; so that the local, the economic interest, as well as original products, and those which were the result of decomposition or alteration of original products, should be placed together, being the only way to prevent that confusion which is produced in the mind when all are in juxtaposition. The first floor is reserved for the great masses of original products, in their order of succession, the object of which is to make known the history of the earth by the products which have followed each other in regular sequence. The arrangements on the first are nearly completed, wanting a few more tables. Those of the gallery are not commenced, excepting temporarily by Mr. Mather; but enough there will be done, to show the utility of that reservation, or the collection which will there be exhibited.

The plan of arrangement upon the lower floor, consists in having a Table with a glass cover for each rock, group or geological element, with the name in large printed letters on the front side of the table; having nothing within each table but what was known with certainty to belong to it as an original product, each product having a place, and each product in its place. The tables, as they represent a rock or group, are arranged around the room, at some distance from the walls, in the form of a parallelogram, and in the order of their succession, commencing with the primary, placed near the door at the left hand, the order being from left to right. Thus, in a few hours the examiner is carried from a table which contains the rocks of the Primary system, to the one which holds those of the Catskill group; at the right of which is another table, containing a suite of the Coal rocks of Pennsylvania, placed merely for those unacquainted with them, that they might have an opportunity of at once observing the difference between them and all those rocks below, or to the left hand, which form the

New-York system. The whole of the rocks of the State end with an adjoining table, which contains specimens of the New redsandstone, and its crystalline associate, commonly known as Trap rock.

Besides the arrangement of superposition or succession by tables of the different rocks or groups, the tables themselves, in all cases where two or more divisions exist, exhibit likewise the succession by specimens; those in the first row, or nearest the spectator, being the lowest in the group, and the succeeding rows rising in their order to the upper surface of the group. Thus, the four divisions of the Onondaga-salt group are arranged in their respective order.

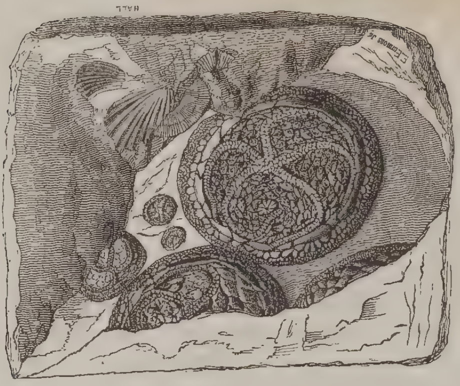
As the tables do not average more than about sixty specimens, there are upright cases, lettered and numbered, to correspond with such tables as are abundant in different kinds of rock or fossils, so as to give the required illustration.

The specimens collected in this district for the colleges, since the Reporter has had it in charge, are now ready for distribution; amounting to thirty-nine boxes divided into seven parts, the parts lettered from A to G, and each part numbered according to the number of boxes therein, having the mark 3 D or Third district upon each box. The collection made for the same institutions by Mr. Conrad and Dr. Boyd, the first year of the Survey, before the third and fourth districts were altered, will form a part of the collection of the fourth district.

In closing this Report, the writer directs attention to this negative fact: that no notice appears in any of the reports which have come from him, of services, kindness, and attentions having been received by him from the inhabitants of the third district, although a like notice is common in most works of the kind. The desire is, that the omission shall be well understood to arise from no other cause than the wish not to particularize; and to mention the names of all with whom he has been placed in any of these relations would, in accordance with the opinion which he holds, be incompatible with the plan of this work. Since the completion of the outdoor part of the Survey, and while engaged in preparing and printing its results, he can not, however, refrain from expressing his obligations, in common with those of his associates in the Survey, to Mr. JOHN PATTERSON, the gentleman employed by the State Printer to supervise the proofsheets of the work, for the care and attention he has devoted to his task; an employment for which his general acquaintance with literal and natural science renders him eminently qualified.

There being no time before that part of the Report which relates to the Hamilton group went to press, to have a wood-cut of the *Hamilton agelacrinite* prepared, it is placed here at the conclusion of the entire work.

80.



Hamilton agelacrinite (Agelacrinites hamiltonensis). [See page 158.]

THE END.

# *ERRATA.*

Page 22, 10th line, for "particular", read "partial".
28, 4th line, for "they rest", read "it rests".
36, 5th line from the bottom, for "Illeneus", read "Illænus".
61, 4th line from the top, tenth word, for "observed", read "obscured".
94, 7th line from the top, for "is", read "as".
104, 11th line from the bottom, "for none have been removed", read "no gypsum being at that time uncovered or exposed".
113, 2d line, for "their precise range", read "its precise range".
139, woodcut 33, the section of the bone is marked No. 6, instead of the shell between the bone and the *Priscan atrypa.*
148, for "Paley B. Babcock", read "Peleg B. Babcock".
157, 3d line, for "Gryphæus", read "Cryphæus". This error was corrected in some of the sheets.
189, 4th line, substitute "but", for "better".
197, 5th line from the bottom, for "Salina", read "Salmon river".
210, 7th line, insert "other" after "several".
254, 21st line, for "these fossils" read "those".
295, 10th line, a period after "each other"; then read, "At Port Crane, far", etc.

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